THE JOURNAL OF NON-FERROUS METALS

VOL. 95 No. 16

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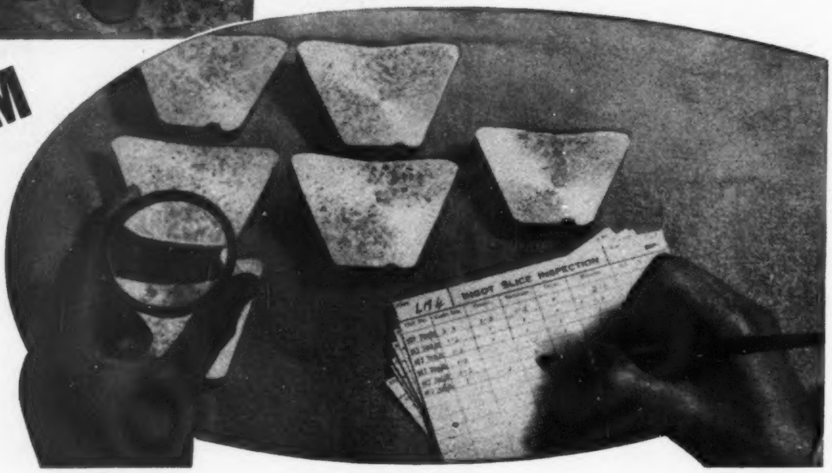

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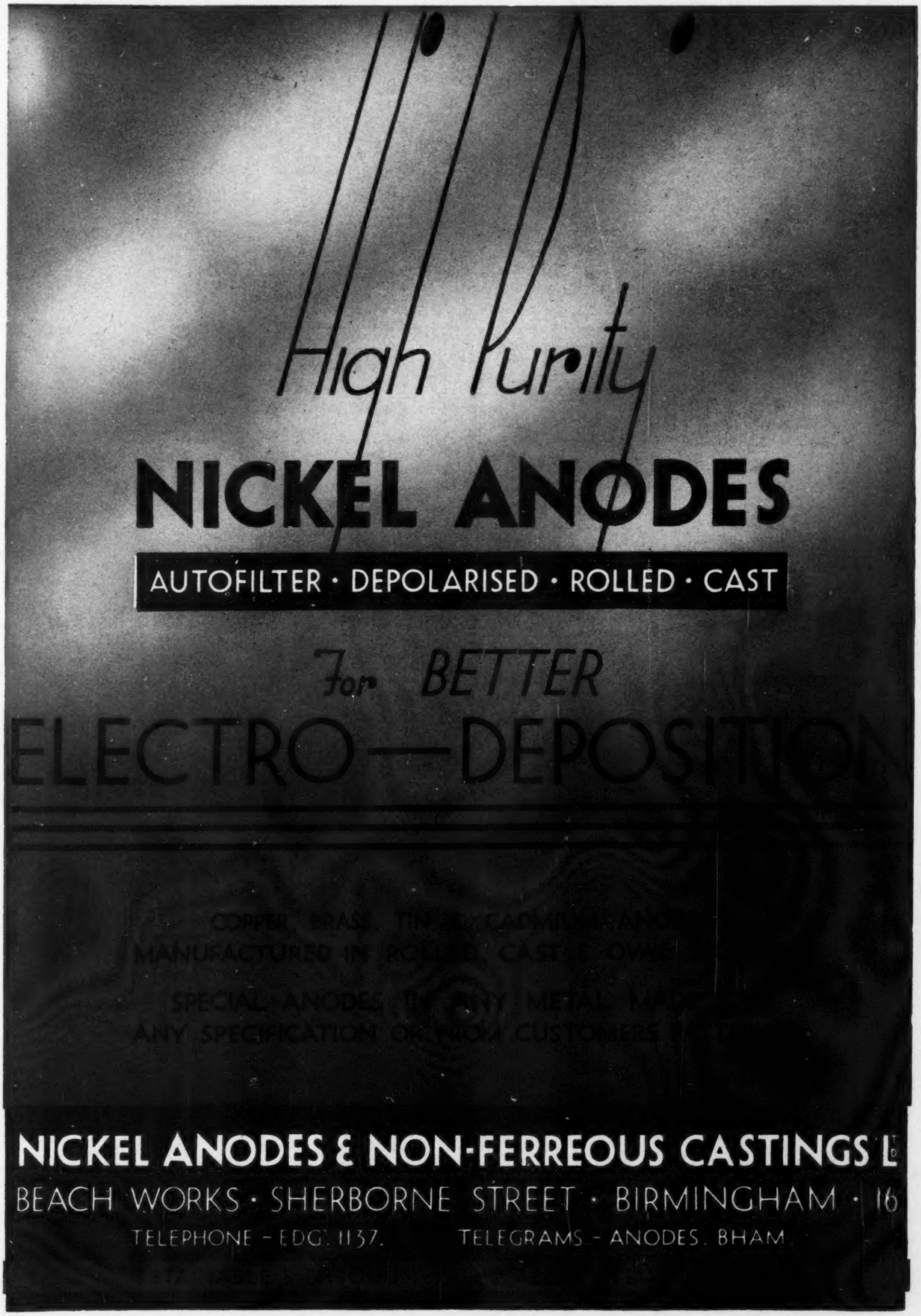
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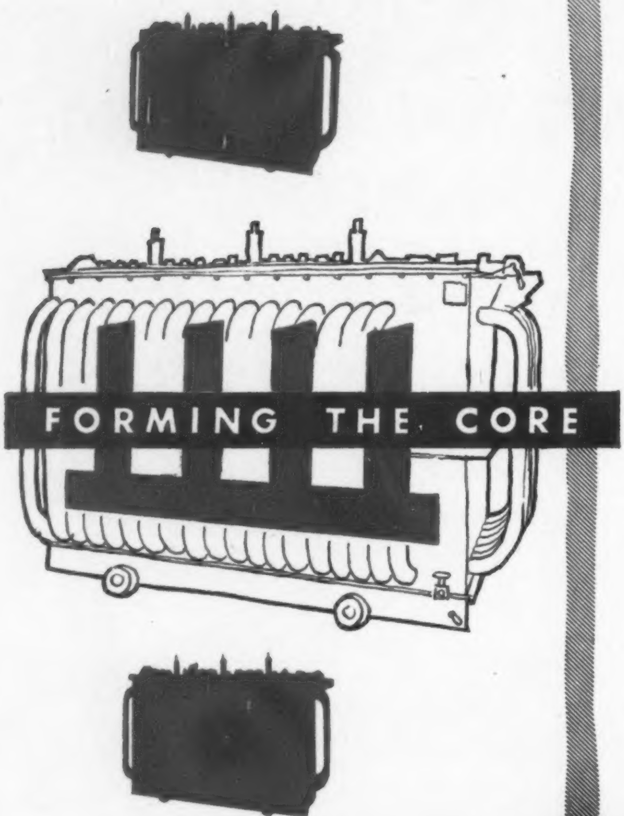
FORMING THE CORE

METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

27 NOVEMBER 1959 VOLUME 95 NUMBER 16

CONTENTS

PUBLISHED EVERY FRIDAY BY ILIFFE & SONS LIMITED

Editorial Offices: 9 Charlotte Street, Birmingham 3 . Telephone: Central 3206

Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Tel.: Waterloo 3333. 'Grams: "Metustry, Sedist, London"

Branch Offices: MANCHESTER: 260 DEANSGATE, 3; telephone, Blackfriars 4412 and Deansgate 3595 BIRMINGHAM: KING EDWARD HOUSE, NEW STREET, 2; telephone, Midland 7191. COVENTRY: 8-10 CORPORATION STREET; telephone, Coventry 25210. GLASGOW: 26B RENFIELD STREET, C.2; telephone, Central 1265

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METAL INDUSTRY

VOLUME 95 NUMBER 16 27 NOVEMBER 1959

Foundry Health

KNOWN and potential health hazards in non-ferrous founding form the subject of the report, recently issued by the Ministry of Labour, of the Joint Standing Committee on Safety, Health and Welfare Conditions in Non-Ferrous Foundries. There appears to be evidence that there may be more pneumoconiosis in non-ferrous foundries than had been supposed in the past, and emphasis is, therefore, laid on the importance of keeping the amount of dust generated to a minimum. In particular it is suggested that castings (other than die-castings) should not be given to dressers until they have been treated in some form of mechanical blasting equipment. In this way the amount of dust remaining on the casting after mechanical fettling is small enough to be dealt with easily by a local exhaust ventilating system at the dressing bench. Again, wire brushing should never be done without local exhaust ventilation, either fitted to the bench or to the wire brush itself using the low volume high velocity exhaust system.

Fumes are also a source of danger. Although zinc ague is less common than it was, it still occurs when yellow brasses are cast if the fumes are not controlled. It may also occur occasionally with alloys with a low zinc content (e.g. gunmetal) if the casting temperature of the alloy is high. The casting of lead requires special precautions and even when casting leaded gunmetal there is some slight risk of lead absorption. No case of beryllium poisoning has yet been known to have occurred in foundries in this country, but wherever beryllium fumes are produced there is a risk of poisoning, even at extremely low concentrations of 2·0 microgrammes per cubic metre. There is, therefore, the necessity for the highest possible standard of control if beryllium is used, even if this means total enclosure. The fumes of cadmium oxide, given off when alloys containing cadmium are cast, are also poisonous, as is the phosphorus pentoxide emitted when phosphorus is added to molten metal. Although selenium and tellurium themselves are relatively non-toxic, they do form highly toxic inorganic compounds. The metals should, therefore, be treated with care and fumes from them should not be allowed to pollute the foundry atmosphere. Fumes in general can be kept at a minimum by keeping the temperature of the molten metal as low as possible, never overheating in the furnace, and by reducing to a minimum the distance between melting furnace and casting point.

Detailed knowledge of the effect on the health of employees of breakdown products of the variety of fluxing and degassing agents used in the foundry is not available. There is, indeed, no evidence that they are dangerous but since many of the compounds are in themselves toxic agents, there is no room for complacency. Chlorine obviously requires control, and it is suggested that nitrogen-degassing should be substituted wherever possible. The main component of the fume emitted when hexachlorethane is added to molten aluminium is thought to be aluminium chloride, an irritant substance, which, therefore, should be removed by ventilation. Care is also necessary in handling fluoride-containing fluxes, while manganese dioxide, used in certain fluxes to produce oxidizing conditions, can give rise to a chronic form of poisoning which affects the nervous system; no cases, however, are known to have occurred in foundry practice.

On the known risks the industry should act as soon as possible; the potential risks should be studied so that they may not be introduced inadvertently with new processes. There is no doubt that medical supervision is desirable wherever it can be arranged, and that a general medical survey of the industry would help greatly by establishing the type and magnitude of the health risks involved.

Out of the MELTING POT

No Principle

OVER two months ago (this page, METAL INDUSTRY, 18 September 1959, p. 114), I outlined the principle of film or layer etching as a means of gaining three-dimensional control over chemical machining, e.g. in sinking holes of any desired cross-section and any desired depth, using a constant depth of recirculated etchant. Those skilled in the art should not have needed the additional remark pointing out that the same principle could be used in cases where, instead of chemical etching, the metal is removed by anodic dissolution, i.e. in electrolytic machining. Having done my job and outlined the principle, hoping that somebody else would undertake the job of developing a practical embodiment of the principle, I was interested to find the Anocut Engineering Company of Chicago announcing a new electrolytic machining unit with die-sinking performance. Without outlining the principle, the announcement merely says that material is removed by passing D.C. through a salt solution between positive workpiece and negative electrode. The electrolyte is pumped through the copper or steel electrodes at 100-200 lb/in^2 and is reusable until contaminated with metal removed from the workpiece. The non-rotating shaped electrode can be plunged directly into the workpiece at penetration rates of 0·001 to 0·005 in/sec. Metal removal rates range from 0·030 to 0·3 in^3/min. Normally, a removal rate of 0·1 in^3/min. can be concentrated in 1 in^2. The machine will cut holes and slots as small as 0·050 in. diameter. There is no mention of the depth obtainable.

Don't Shoot

RECENT accusations that not enough research is being carried out by the machine tool industry, which consequently is said to be falling behind its foreign counterparts in some respects, are unfair both to the machine tool industry and to research. They are based on the popular view of research (fundamental research, though this distinction is hardly ever made) as an unfailing means of working miracles, and on the likewise over-simplified opinion that an industry that does not avail itself of this means and fails to produce rabbits out of a laboratory must be unprogressive or worse. So far as the machine tool industry is concerned, it is not so much a case of engaging in successful legerdemain, but rather that of a pianist trying to do his best. Please don't shoot him. Before pulling out your gun, you ought to realize that he was, and for that matter still is, a highly skilled performer, who for many years performed successfully both at home and abroad before receptive and enthusiastic audiences, but who of late seems to have been falling on evil times. Times have changed, and tastes with them, but it is hardly his fault that the customers still expect him to play the old piano, with which they have been familiar in their favourite saloon all these years, and then suddenly start shooting at him because it does not sound like an electronic organ. They had better decide whether they want more skill, more elaboration, more twiddly bits, or even, perhaps, a player piano, or whether they want, and are prepared to accept, something fundamentally new. Just in case they should decide that they do, the pianist might find it advisable to let his mind dwell occasionally on electronic organs and at least get some idea of what types of instruments there are and what they can do. Similarly, to get back to the machine tool industry, it should, without giving up any of its mountainous and still growing accumulations of skill, ingenuity, experience and results of applied research, perhaps just spare a thought or two to how metal can be removed by "tackling" its surface (by cutting tools, electric sparks, etc.) from the outside as at present, or from the inside. It might even engage in some fundamental research, which, like all the best fundamental research, should start without the remotest connection with the subject that is expected to benefit therefrom.

Cast Joints

SOME methods of fabrication are applicable more or less generally right from the start, while others start by having one or two specialized applications, to which they tend to remain restricted, and never become generalized. Take, for example, the method of forming a joint between the ends of an aluminium and a copper tube. The outside surfaces of the two ends to be joined are provided with a series of thin pointed metal projections, e.g. by cutting screw threads or the like. The two ends are then placed in contact in a die, in which they are surrounded by a suitably-shaped cavity into which is then cast some molten aluminium to form a ferrule or sleeve around the two ends, thereby joining them together. The temperature at which the aluminium is cast, its volume, and the rate of cooling and solidification, are all controlled in such a way as to cause fusion of the ends of the threads on the tube ends, the remaining portions of the threads interlocking with the cast aluminium sleeve so that a combined mechanical and metallurgical bond is obtained between the ends of the tubes and the cast aluminium sleeve. Here we have an example of what is a specialized and very rarely used methods of jointing, but given a wider appreciation of its possibilities and a little more imagination, one could undoubtedly find a lot more applications. Indeed, the casting of metal *in situ* to form at least a mechanical joint between suitably shaped and positioned parts might be extended all the way to the die-casting, or even pressure die-casting, of rivets. In connection with the latter, the designers and manufacturers of pressure die-casting machines would only be too pleased to oblige. And if rivets are too simple to bother to cast, more elaborate formations performing both fastening and various other functions could, no doubt, be visualized and used on numerous occasions. In fact, instead of manufacturing two separate parts and then riveting them together, why not manufacture only one part and then cast the rivets and the other part and join the lot together in a single operation? Elsewhere, in the architectural field, components such as aluminium curtain wall units, roofing panels and the like, which at present rely on elaborate mechanical joints and "perishing" strips of plastics or ditto mastic fillers for weathertightness, would, one would think, be all the better for a cast-in aluminium joint.

Skimmer

INVESTIGATION OF PRIMARY PHENOMENA WITH SINGLE CRYSTALS

Combating Corrosion

LARGE single metal crystals are being employed in research at the U.S. National Bureau of Standards to correlate corrosion with the arrangement of atoms in the crystal lattice. The role played by electrical phenomena and cathodic protection comprises a phase of the continuing programme. One study deals with the nature and mechanism of formation of oxide films on metal surfaces. The effect of illumination on the corrosion reaction also has been studied. By attacking the problem from different directions, the Bureau's corrosion research staff hopes to improve present methods for combating corrosion.

By investigating the primary processes of corrosion, the National Bureau of Standards seeks to discover why metals corrode and how corrosion can be prevented. Thus the studies deal with such topics as the corrosion reactions at the metal surface, electrochemical polarization and other electrical phenomena associated with corrosion, the effects of free radicals on metals at low temperatures, the nature of corrosion in large single crystals, and the mechanism of stress-corrosion cracking. By attacking the problem from these various directions, the Bureau hopes not only to improve methods of combating corrosion, but also to obtain basic data on the properties that may be useful in other fields.

Single Crystal Studies

As the corrosive process is influenced by many factors, a study of metals in their commercially usable state affords little information on the fundamental nature of the process. Such information can best be derived by studying the least complex form of the metal that has the basic characteristics of the whole, that is, metal in the form of single crystals. In this way, many of the corrosion-influencing factors of polycrystalline materials can be isolated, and reproducible results can be obtained.

Single crystals are being used in research initiated at the Bureau in 1955 under the sponsorship of the Corrosion Research Council. Chosen to investigate the adsorbed layers that form on metal surfaces was the metal-water-oxygen system. Copper was selected as the metal because it has a face-centred cubic structure, is readily available in high purity, and the corrosion products formed are few and simple.

Spherical specimens were initially employed in this work because they permit all of the crystallographic planes to be studied simultaneously. When carefully cleaned and polished specimens are exposed to water containing oxygen, different oxide interference colours appear on the various planes. Each colour, readily identifiable from the patterns that are formed, indicates a different rate of growth of the corrosion products.

In one study, experiments were carried out both in open vessels exposed to the atmosphere, and in a closed all-glass apparatus in which the surrounding atmosphere and purity of the water were rigidly controlled. The differences in the composition and nature of the films that formed on similar specimens were attributed to the presence of carbon dioxide in the laboratory atmosphere in the first experiment, and its absence under the controlled conditions of the second. During this study it was discovered that light has a marked inhibiting effect on the corrosion process.

A related effort concerns the influence of atomic oxygen on metals at low temperatures. In this work oxygen is made to pass through a microwave discharge in order to dissociate some of the oxygen molecules. Initial experiments indicate that some reaction does occur between atomic oxygen and copper crystals cooled to 4·2°K. No reaction occurs, however, with oxygen which has not been passed through the microwave discharge. This area of investigation is expected to produce interesting and fruitful results.

In these single-crystal studies, a polarizing spectrometer is used to observe and measure the rate of film growth. This instrument also has been found useful in obtaining data from which the index of refraction of thin gas films can be calculated.

Other work with single crystals has been conducted to study the relationship between surface atomic arrangement and rates of corrosion in acids and alkalis. When large single crystals of high-purity aluminium were exposed to an acid mixture, the configuration of the etch pits that formed on the surfaces differed according to the crystallographic orientation of the specimen. The rates of corrosion on these surfaces varied radically from the rates observed on atomically similar surfaces exposed to an alkali mixture.

During an experiment with the corrosion of monocrystalline copper in an acid, copper was electrodeposited on the specimen surfaces in an attempt to distinguish more readily the facets exposed as a result of attack by the acid. An analysis of Laue back-reflection diffraction patterns showed that the microstructure of the deposit either duplicates the orientation of the base

The cylindrical specimen is an aluminium single crystal grown in a vertical furnace. Specimens in the form of discs, are cut from the crystal and subjected to corrosive media to determine the effect of crystallographic orientation on rates of corrosion. The different shapes into which the specimens corrode (foreground) depend on both the orientation of the specimen and the corrosive medium. The spherical specimen at the top corrodes in the shape shown to the right when exposed to an aqua regia-hydrofluoric acid mixture

crystal or has a continuing and twinned relationship with it.

Galvanic Corrosion

Even the purest metals have many foreign atoms within their lattices. Less pure metals contain non-metallic inclusions, metallic impurities, and other inhomogeneities. Exposure to a corrosive medium of dissimilar metals in contact with each other, or of a metal with surface inhomogeneities causes galvanic (electrochemical) corrosion. Such corrosion also can occur on metal surfaces exposed to non-uniform electrolytes with variations in electrical conductivity, etc. The electrical current associated with corrosive action causes the metallic area with the more anodic solution potential to dissolve, forming a pit in the metal surface. The depth of pitting depends on the amount of current that flows from anode to cathode, which in turn may depend on several factors such as anode-to-cathode area, environment, temperature, and pressure. When the mechanism that causes the first pit to form can be determined, a great advance will be made in understanding the corrosion process.

Galvanic corrosion which occurs on a continuous metallic surface cannot be measured directly. However, the Bureau has developed a method for evaluating this corrosion indirectly, on ferrous surfaces at least. In this method, the currents associated with the changes-in-slope in current-potential curves that occur during cathodic and anodic polarization are measured, and the values of applied polarizing current thus obtained are used to calculate the equivalent corrosion current. This indirect technique has been successfully applied in measuring the corrosion rates of steel in low-resistivity cells and in salt water. A variation of 10 per cent in corrosion rate can be detected in this way.

Now under investigation are the polarizing characteristics of iron specimens alloyed with chromium in various amounts up to 20 per cent, together with a similar series that contains, in addition, 3·5 per cent of silicon. Efforts will be made to use the indirect polarization technique to evaluate other factors affecting corrosion rates. Such factors include temperature, aeration and motion of the electrolyte, heat-treatment, and alloying constituents of the basis metal.

One galvanic corrosion study deals with criteria for the cathodic protection of metals, principally ferrous metals. Although cathodic protection is based on well-founded scientific principles, its application has been the subject of considerable discussion. Insufficient negative potential gives inadequate protection, yet maintaining a greater potential than is required is unnecessarily costly. In investigating this problem, Bureau scientists have made a series of electrical measurements to evaluate the criteria of cathodic protection.

In a part of this work it was found that steel exposed to soil environments varying in *p*H between 2·9 and 9·6 can be protected from corrosion by maintaining the steel at an electrical potential of $-0{\cdot}77$ V relative to a saturated calomel reference cell. Recent laboratory experiments showed that $-0{\cdot}77$ V is also the optimum potential for protecting steel in salt water.

Stress Corrosion

The crystal structure of metals has a direct bearing on stress-corrosion cracking, a particularly damaging type of failure resulting from the combined effects of stress and corrosion. Cracking may be either intercrystalline, as in aluminium alloys and low-carbon steels, or transcrystalline, as in magnesium alloys and stainless steels. Of particular interest are the copper-zinc alloys, in which the attack is intercrystalline in the alpha phase and transcrystalline in the beta phase.

Residual or applied tensile stresses—frequently far below the yield strength of the material—may produce this type of failure even though the corrosive effect itself is very mild. Specific environments are often required, but in some cases a number of different media may cause cracking. Most investigators agree that practically all metals and alloys are subject to this failure when the necessary combination of stress and corrosion is present.

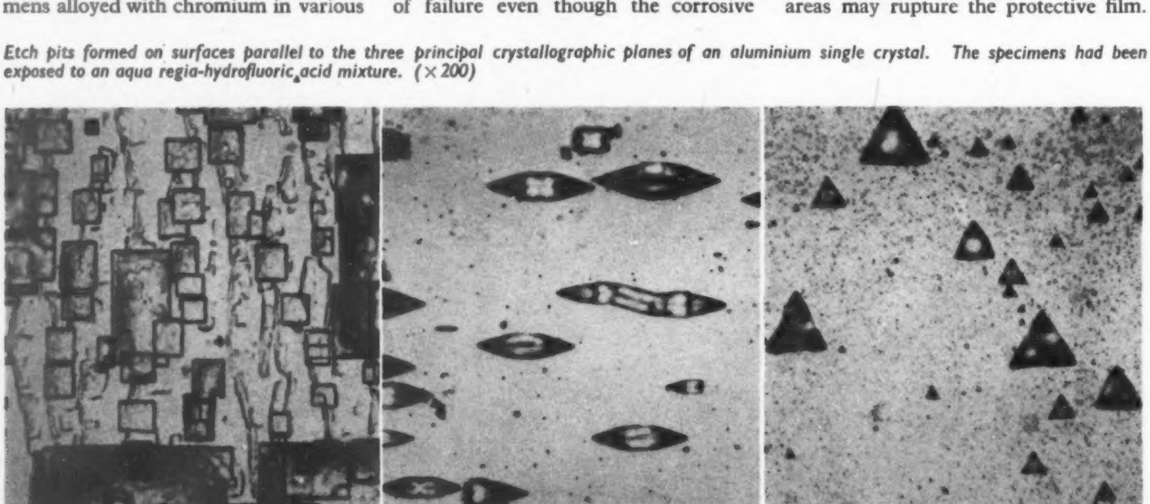
When most metals are exposed to ordinary atmospheres, a thin oxide covering quickly forms that tends to protect the metal from further corrosion. Stress-corrosion cracking apparently starts with a scratch or break in the protecting film. In investigating this type of cracking in several metals, the Bureau found that the process usually is continuous to complete failure. However, if shifts in stress concentrations permit repair of the film from time to time, the process may be discontinuous.

For years stress-corrosion cracking has been a problem in the production of wrought-brass articles. During spinning and deep drawing, stresses are set up which remain in the metal unless removed by annealing. In studying this problem, the relationship between crystallographic orientation and cracking of both alpha and beta brasses was investigated. Experimental results showed that the intercrystalline cracking in alpha brass apparently depends on the relative orientation of the crystals bordering the cracks, and hence on the crystal boundary energy. In beta brass, transcrystalline cracking occurs in crystals oriented most favourably for slip, and in planes that are approximately normal to the applied stress.

Experiments conducted with a magnesium alloy indicated that the development of cracking is dependent upon strain rate. However, these studies present very strong evidence that stress corrosion is partly an electrochemical phenomenon and not one of mechanical fracture only.

Recent work on austenitic stainless steels disclosed that sporadic but repeated creep in favourably oriented areas may rupture the protective film.

Etch pits formed on surfaces parallel to the three principal crystallographic planes of an aluminium single crystal. The specimens had been exposed to an aqua regia-hydrofluoric acid mixture. (×200)



This rupture provides a small film-free anodic area where stress corrosion can begin. By making the stressed steel become the anode in an external circuit, the corrosion can be accelerated. On the other hand, the corrosion can be prevented or stopped by application of a cathodic current.

In the near future, the Bureau expects to investigate corrosion inhibitors of the precipitate or barrier type. This work will explore the kinetics and energy associated with the formation of the precipitate, and the forces binding it to a metal surface. Additional corrodents will be studied in the work on aluminium single crystals, and single-crystal research will be extended to other high-purity metals.

A specimen in which most of the variables can be controlled has been devised for future stress corrosion studies. Investigations have been started on the influence of temperature and high pressures on the mechanism and kinetics of metal oxidation, as well as additional work on the reactions between atomic oxygen and metallic surfaces. The results of these and related studies are expected to provide science and industry with solutions to some of the practical corrosion problems that are causing concern today.

PRINCIPLES TO BE OBSERVED IN USING FLUX-COATED ELECTRODES

Welding Aluminium and Its Alloys

I—Manual Metal-Arc Process

METAL-ARC welding of aluminium is carried out with flux-coated aluminium electrodes: as the flux melts off the core wire, it removes the oxide film from the workpiece and, by covering the weld pool, aids the flow of liquid metal in the joint and prevents its oxidation. The flux coating also improves arc stability: bare electrodes are completely unsuitable for arc welding aluminium.

In general practice the work is horizontal and welding is done in the downhand position from one side only. Although welding in other positions is possible, more skill is required for aluminium than for steel.

Provided it gives a stable arc, standard D.C. welding equipment is suitable. It must be of drooping characteristic type, giving an open-circuit voltage of 60-70 V. The operating voltage is about 25 V—depending upon arc length and type of electrode—over a current range of 40-450 amp. Ammeters and voltmeters are sometimes omitted because of the hard usage given to welding sets, but in such cases separate instruments should be used to check the machine settings.

Reverse polarity is general, but as the electrodes are flux-coated trial may be necessary to take into account the effect of flux composition on the arc conditions. The D.C. arc between an aluminium electrode and aluminium workpiece is inherently unstable and flux coatings include in their composition agents that act as stabilizers.

Irrespective of electrode or work material, however, instability also arises because, in the normal metal-arc welding range, the voltage across the arc decreases as the current through it increases. Welding generators are designed to have a steeply drooping characteristic in order largely to overcome this, but further compensation may be effected by adding a resistance of ⅓-½ ohm in series with the arc.

The use of A.C. tends to produce an unstable arc, for which at one time the only cure was to bring the electrode close to the work; but using an electrode of aluminium, with its low melting point, globules of metal would fall into the weld pool and in so doing short circuit the arc, which would be extinguished.

A recent development is to stabilize the arc by injecting a high-voltage, high-frequency current, and thereby maintaining a longer arc. As the additional equipment is merely a high-frequency oscillator, which can be fitted to any standard A.C. welding transformer, this device, when fully established, should make plant used for steel welding easily applicable to aluminium welding. To obtain a smooth and uniform weld bead the work should be preheated to 120°-125°C.

The electrodes consist of a wire core with a flux covering which contains chlorides and fluorides of the alkali and alkaline earth metals as the active fluxing agents. The composition of the core wire is important and in general falls into three categories: pure aluminium, aluminium-silicon alloy and aluminium-manganese alloy.

The aluminium electrodes in common use in this country are specified in B.S.S. 1616:1950, "Aluminium Electrodes for Metal Arc Welding", together with sizes, tolerances, wire compositions and performance tests—including strength. The aluminium-silicon alloy recommended in the specification contains about 5 per cent silicon, but a higher content, 7·5-9 per cent, gives higher weld strength and is in common use. The aluminium-manganese alloy recommended contains about 1¼ per cent manganese.

Core wires have also been made in other alloys, such as aluminium-5 per cent silicon, aluminium-10-12 per cent silicon, aluminium-6 per cent magnesium and the alloy containing about 1 per cent each of silicon and magnesium. Progress has also been made in welding aluminium-copper alloys by means of electrodes with core wire having copper as the principal alloying element.

The quoted size of an electrode is the size of the core wire before it is coated with flux and in general ranges from 12 to 4 S.W.G. Electrodes are usually about 15 in. long and are coated to within about 1 in. of the end, which is gripped in the electrode holder.

If a wrought alloy to be welded contains only a small proportion of alloying element—for example, less than 2 per cent of manganese, silicon, magnesium or copper—then the 5 per cent silicon electrode is very suitable. Pure aluminium should be welded with a pure aluminium electrode.

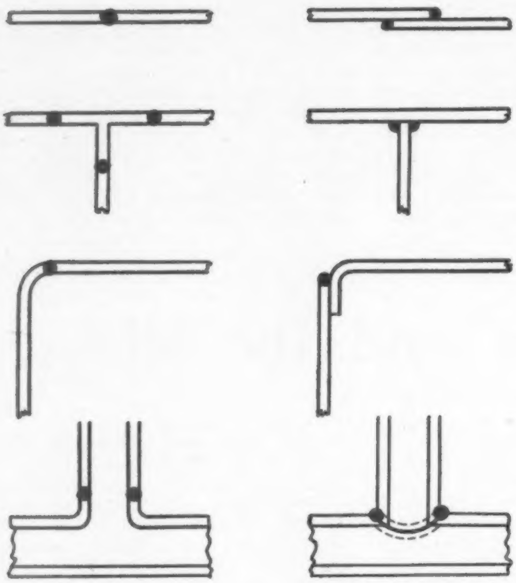
In the case of aluminium-magnesium alloys there is always a loss of magnesium during transfer across the arc, and this should be taken into account. Thus, if the parent metal contains 2½ per cent magnesium, it should be welded with an electrode containing 5 per cent magnesium.

Castings such as those containing silicon as the chief alloying agent can readily be repaired or built up with an electrode of the aluminium-silicon type. Castings of compositions different from these may not be suitable for repair by welding owing to tendencies to cracking. The problem may, however, sometimes be solved in specific cases by using a rod of the same composition as the casting and by preheating in order to reduce stress.

A general guide to the current

TABLE I—TYPICAL WELDING CONDITIONS

Material s.w.g.	Electrode Size s.w.g.	Current Range amp	Plate Gap
16–14	12	40–55	Close butt
12–10	10	65–75	Close butt
6–4	8	100–145	$\frac{1}{16}$ in.
3–1	6	145–190	$\frac{1}{8}$ in.
0–000	6	190–230	$\frac{3}{16}$ in. or bevelled 70° with $\frac{1}{16}$ in. step
0000	4	230–300	$\frac{3}{16}$ in. or bevelled 70° with $\frac{1}{16}$ in. step



RECOMMENDED NOT RECOMMENDED

Joint designs shown at left are recommended for use in manual metal-arc welding. Those on the right should not be used unless special precautions are taken to avoid corrosive fluxes

conditions required for typical welding operations is given in Table I, but these figures need to be modified if the work, in the thicker gauges, has been preheated. Considerably higher current densities may be used, however, with the objects of increasing welding speed and reducing the area of the heat-affected zone and loss of properties.

The effect of increasing current density on welding speed is illustrated by the fact that with a 6 S.W.G. electrode, a current of 155 amp. gives a welding speed of 12 in/min., whereas 320-360 amp. gives twice the welding speed.

The arc length should be kept as short as possible, never exceeding $\frac{1}{4}$ in.: $\frac{1}{8}$-$\frac{3}{16}$ in. is usual. Maintaining a constant short arc length is not easy, since fumes interfere with the operator's view, but it can be achieved with practice. The current strength should be carefully adjusted to suit the thickness of the material being welded. The rate of deposition and consequently of electrode consumption with aluminium is very much more rapid than is usual with steel.

Flux usually consists of a mixture of chlorides and fluorides, although other salts may be present. For metal-arc welding, mixtures generally similar to those used for gas welding are supplied as coatings to the electrodes, but in this case the flux may include binders which prevent the coating from chipping or flaking off the electrode, and also help to stabilize the arc. Further, some electrodes give a slag that is self-lifting —one that flakes off on cooling.

The use of flux imposes certain limitations due to the possibility of corrosive action by any residues trapped in welded assemblies and the discontinuity they may create in the weld. Joints must be so arranged that there is ready access to each side of the weld for thorough cleaning, and the configuration of the joint must be such as to avoid flux entrapment, for example, in corners and lapped seams. This generally means the use of butt joints only, but fillets can be welded with flux-coated electrodes—of the type giving a readily controllable arc—although the ends of the joints must be sealed to keep out moisture; flux inclusions are then unlikely to cause trouble.

When corner welds are necessary the angle should be radiused. For butt welds one run only is needed with thicknesses up to $\frac{3}{16}$ in.; above this thickness two or more runs are required, the runs being made from each side if necessary.

Flux-coated electrodes are usually water-absorbent, and whether of aluminium or, for example, steel, they should be packed in airtight containers and stored warm and dry: aluminium electrodes may need re-drying at 130°-160°C. before use. Experience has proved that furnace-drying of electrodes and storage in ovens is of marked benefit in stabilizing the arc and producing sound welds.

When metal electrode containers are used, a few turns of resistance wire wound around the container and connected across the welding transformer secondary will suffice to keep the atmosphere inside the sheath at a safe minimum temperature.

In preparing and setting up the work, cleaning, degreasing and scratch-brushing are required, also backing strips and jigs where necessary. In the welding of castings, whether to repair fractures or to join assemblies, the use of flux-coated electrodes imposes the limitations already mentioned.

Castings are invariably preheated before repair by metal-arc welding, but this is by no means essential for joining wrought aluminium. Depending on the thickness of the parent metal, however, it is found that preheating to about 200°C. reduces any tendency to porosity, and it is generally advisable in order to ensure adequate welding heat for a thick component without risk of melting adjacent thin sections while joining. The preheating of castings in an oven is much to be preferred as it gives better control and more uniform heating than by the blowpipe or other unenclosed source.

Tacking, where necessary, follows preheating without delay, and, in general, whatever the type of joint in wrought material, the edges should be accurately and closely tacked over the whole length. Tack spacing depends on material thickness and also on the amount of support given by jigs: it varies from about 1 in. to 6 in. The tacks, while being adequate, must not be so large as to spoil the finished weld profile; they may need trimming to reduce their height, and they must also be thoroughly freed from slag before final welding.

Some difficulty is occasionally experienced in starting an arc weld with an aluminium electrode, due partly to the rapidity with which the metal melts and also to the insulating characteristics of the flux coating at the tip. The easiest way of striking the arc is to draw the end of the electrode lightly across the work in a similar manner to striking a match. If contact is too heavy, the amount of metal melted will be excessive and the rod may stick to the work.

The arc should be struck as near as possible to the point where welding is to begin, as welding once started is much more rapid than for steel. The electrode is usually held perpendicular to the work in order to keep the arc as short as possible, but for convenience a deviation up to 20° from the vertical can be allowed in downhand welding.

In downhand welding, the electrode should move in a straight line along the seam without weaving. For thick material it is necessary to build up a bead and the electrode should preferably be moved only back and forth in the direction of the weld. Very skilled welders can achieve excellent results on thick plates by slight weaving but it is considered more satisfactory to use as large an electrode diameter as possible and to maintain uniform forward motion.

The speed of welding depends on the current conditions and the operator's skill, but it is usually about three times that for mild steel. It increases as the electrode size is increased and, further, it should be increased as the weld progresses, in order to allow for the rise in temperature of the parent metal. Too rapid welding or low currents do not give the required penetration, while welding that is too slow or a current that is too high give an

(*Continued on page* 343)

Finishing Supplement

Progress in Polishing

REVIEWING some of the recent developments in polishing equipment, compounds and processes, a one-day Symposium was organized on Wednesday of last week at the Royal Festival Hall, London. The meeting was held under the auspices of the London branch of the Institute of Metal Finishing, four Papers being presented. These dealt with barrel finishing, machine polishing, liquid polishing compounds, and chemical and electrolytic polishing. Abstracts of two of the four Papers are published here; the other two will appear in a later issue.

Some Aspects of the Use of Liquid Polishing Compounds

By S. J. SCOUSE

FOR convenience, polishing may be divided into the following groups: cutting operations, in which metal stock is removed to produce a uniform ground surface; glazing operations, in which a certain degree of shine or lustre is imparted, usually following a cutting operation; polishing operations, in which a bright surface is produced, free from definite scratch lines; colouring operations, in which the final depth of colour is developed and excess grease removed.

Liquid polishing compounds are available for carrying out glazing, polishing and colouring operations, the compounds consisting normally of an oil/water emulsion of fat, wax or fatty acids, in which is suspended the appropriate abrasive.

Considerable work has been done on liquid compounds for carrying out cutting operations. This work has shown that, to achieve any appreciable cutting or metal removal, the abrasive must be anchored to the polishing mop. This is not achieved with fat emulsions, and it appears that a resin emulsion will provide the desired degree of anchoring.

The question of suspending the abrasive in the liquid phase is of great importance if the liquid compound is to be successful. Stirring before use is an unreliable expedient, and continuous stirring during use can be detrimental with compounds which have thixotropic properties. Indications are that viscosity of the emulsion is not of overriding importance. In certain tests extremely thick emulsions gave more sedimentation than some thinner ones.

Reverting to the question of cutting compounds, some early work involved the use of soap solutions of fairly high viscosity as the liquid phase. Promising results were obtained in respect of settlement, when using comparatively coarse abrasive (90 grit) in such a medium, but no marked improvement in cutting properties was achieved over those obtained with a finer abrasive (220 grit).

It is emphasized that this class of compound, in which the abrasive is not anchored to the polishing wheel, is only suitable, at best, as an alternative to emery brushing or grease mopping, and in view of this it seems wise to incorporate a proportion of fat, fatty acid or wax in the compound and obtain complementary benefits from these.

Liquid polishing compounds, when applied to the surface of a rapidly rotating polishing mop, are subjected to considerable centrifugal force. The compound is not thrown off provided the centrifugal force on the compound is less than the natural "stickiness" between the compound and mop surface. It is, therefore, necessary to keep the weight of compound on the mop face to the minimum, and to ensure that the compound is distributed as uniformly as possible.

As a result of a number of preliminary and unsuccessful trials, it was decided to employ a conventional air-operated atomizing spray gun, to apply liquid compound to the mop, and certain points connected with the design of such guns are worthy of inclusion to enable the proper selection to be made. Amongst the desirable factors are: robust construction; ease of cleaning and adjustment; large connections for liquid compound hose; self-cleaning nozzles and jets; ease of varying degree of atomization; and width of spray.

The spray gun design, operation and positioning are important in transferring the compound effectively to the mop, but a further factor is the control of the total quantity of compound used each minute or for each part. Generally speaking, the compound should be applied just before each polishing operation commences, and in the interests of economy, and to ensure speedy drying, the minimum quantity of compound should be used at each application. Obviously, in some cases two applications or more may be needed in polishing one part, whereas in others increasing the amount applied in a single application, up to the maximum the mop will retain, may be preferable. With either procedure, a timing device is needed to control: (1) The duration for which the compound is applied. In practice this varies between 0·5 and 5 sec. approximately. (2) The moment during the polishing cycle at which application of the compound starts.

In connection with the application of the compound on the mop to which it is applied, one of the following positions for the gun is customary: To the "bite" formed between the mop and the article; radially to the mop surface above the point of contact; almost radially to the mop surface on the side remote from the polishing point; almost tangentially to the mop surface and against the direction of rotation of the mop.

The use of liquid compounds for hand lathes has been considered but, in the writer's opinion, is not, at the moment, a practical proposition, although hand lathes are satisfactory for exploratory tests.

When using liquid polishing compound, the lids should be replaced on tins or drums used for containing the compound. All liquid compounds tend to dry out and form a skin when exposed to the air, and this can lead to blockages in the gun or in the hoses.

A useful method is to pack the compound in polythene bags inside the transport container. The liner keeps the contents free from contamination and, when the contents are nearly used, the liner can be lifted from the drum and the remaining compound squeezed into the pressure pot. By this expedient, no compound is wasted by remaining at the bottom or on the sides of the drum. Another approach is to provide containers that can be placed straight into the pressure pot without pouring out the contents.

The viscosity of liquid polishing compounds is affected by changes in temperature, so they should be kept as far as possible at a constant temperature. Alternatively, time should be allowed for supplies, drawn from a cold store room, to attain the temperature of the polishing shop.

Stocks of liquid compound should be used in rotation to avoid excessive storage times. Thinning of liquid compounds with additional water is not recommended, as it is difficult, without the use of high speed stirrers, to disperse the water uniformly throughout the compound. Usually, fairly thick compounds can be employed successfully by increasing the pressure on the pressure pot, but where this is not possible the manufacturer of the compound should be called upon to provide a thinner material.

When the polishing machine stops work, the compound supply to the spray gun should be turned off at the pressure pot, so that the fluid line remains filled with compound. By this means, provided the needle on the gun is working effectively, the spray gun can be stopped and started, at will,

after reasonable shut-down periods. Leaving the fluid line half filled with compound can lead to blocking, as the material tends to dry out and, furthermore, difficulties can arise due to formation of air locks when refilling a partly empty line.

For most installations, pressure pots are convenient and versatile, but on larger installations use has been made of a pump feed for the compound, thus avoiding the filling of pressure pots and enabling extended operation to be maintained.

Improved manufacturing methods and increased demand, together with competition, have led to the price of compounds being reduced, in many cases very substantially, so that liquid compounds are now available at prices close to those for bar compounds.

Accurate comparative tests comparing liquid and bar compounds show that less liquid compound is used per hour or for polishing a standard number of articles. Obviously, the saving effected depends on the efficiency with which bar compound is employed, and reductions of from 25 to 66 per cent have been achieved. Comparisons have also been made between bar compound applied by hand and mechanical applicators. Neither method is, however, as satisfactory as liquid compound, which can be used completely.

Other advantages of the liquid compounds include low maintenance of spray guns, reduced mop wear, simplified cleaning, cleaner working conditions, and less idle machine time. They are particularly valuable on wide-faced mops and on mops rotating at slower-than-normal speeds.

It is not expected that, in this country, there will be an immediate and complete change to liquid polishing compounds, because of the large capital investment which this would incur, bearing in mind the present widespread use of mechanical applicators. Nevertheless, it is felt that this change will come, particularly as new polishing machines are put into use.

Progress in Machine Polishing

By J. H. BRYAN and J. P. DEWAR

GENERALLY speaking, semi-automatic polishing attachments are operated in conjunction with a pedestal type polishing motor, and the selection of a polishing motor of sufficient h.p. and running at the desired speed is important.

The output obtainable on these attachments will vary considerably from approximately 30 to 100 articles per hour for each attachment. One person usually operates two attachments quite easily and in some cases three, or even four, attachments.

In the best known type—the single spindle attachment—used for circular components such as aluminium or stainless steel saucepans, lamp body shells, electric light fittings and similar components, the article to be polished is fixed to a suitable jig or work holder attached to the universal head of the unit. Thus the article can be set at the required angle for contact with the polishing mop. In addition, an adjustable arm is provided on the attachment which gives lateral movement to the whole assembly, thus enabling the component to traverse across the face of the mop.

Variations of this type of attachment where two, three or four spindles are provided, enable a component to be loaded whilst another is being polished. A further development with this type of attachment is a hydraulic unit which enables articles up to 16 in. diameter and 12 in length to be polished.

For small size components of irregular shape a special type of attachment has been designed which uses formers. Examples of the components which can be polished by this method are shaped lamp shells, door plates, over-riders, etc.

Fully automatic machines can be divided into three main categories: rotary table machines; conveyor machines of the conventional return type; and special conveyor machines of the universal type using mops up to 24 in. in length operating at lower speeds than the normally conventional range.

Rotary table type machines are made for continuous or indexing operation. The continuous type are usually used for small components such as lipstick cases, small bezels, valve tappets and similar articles. The requisite number of polishing heads required are placed around the table and the components revolved beneath mops which are shaped to conform to the diameter traversed by the component. In the loading and unloading position, it is customary to arrange suitable automatic unloading devices to assist the operator in keeping pace with the high outputs involved which can be as much as 1,000 to 1,500 parts/hr.

Indexing machines are used where it is required to dwell for a period of time under each polishing head to cover adequately the contour of the article, and at the same time ensure a desired finish to the surface.

Conveyor type polishing machines consist of a straight line motor-driven chain on which are mounted platens for carrying the jigs or work holders with a suitable number of polishing heads arranged on each side of the conveyor or unit. The conveyor units themselves are usually of two types, the return type where the work holders are traversed down two sides of the structure in a horizontal plane and returned to the same position for loading and unloading, and secondly, the "over and under" type where the conveyor traverses the length of the machine and returns underneath in a vertical plane.

Polishing heads used in conjunction with rotary table and conveyor type machines, may be either the fixed head or the follower type head.

The fixed head is normally used when it is not necessary to have any lift during the polishing operation and where the component has a flat surface.

The follower type head, which is spring loaded and arranged with either an air cylinder or toggle action to provide lift, is used where irregular surfaces have to be polished and where it is necessary for the mops to be removed from the surface of the component between polishing operations to prevent dragging or "wipe off".

A more unusual type machine comprises a conveyor of rectangular shape supporting a train of carriages. These are coupled together to form an endless train driven by a variable speed motor unit. Work holders are mounted on the carriages and can also be carried on vertical or right angle spindles arranged to rotate continuously or oscillate as required. The conveyor is built in sectional form and can be extended or reduced in size by adding or taking away sections. A feature of this machine is the automatic control which is provided to take up mop wear. Spindle speeds for mops are arranged as low as 1,000 r.p.m., thus enabling mops to be used with spacers between sections. This arrangement allows the component to be buried in the mop face ensuring that all surfaces presented to the mop are polished. This is a distinct advantage where components of special shape or contour require to be polished.

In machine polishing, the trend in recent years has been the gradual discarding of disc mops and stitched mops in favour of ventilated bias mops, and sisal has been used increasingly for mops since it is ideally suited, in place of brushing operations on all sorts of mild steel pressings prior to electroplating processes.

Sisal is now being used on many jobs where tampico or Mexican fibre wheels were formerly used. There is still a demand for fibre polishing wheels, but here again, the trend has been towards impregnated fibre wheels. A very important development in recent years is the ventilated fibre polishing wheel, where cool air is introduced between the fibre sections, helping to dissipate the heat which is generated in polishing. In manual polishing, bias mops are being increasingly used. The cooler working of bias mops helps to dissipate the heat generated, whilst the faster cut and longer life offered by bias mops make them, in some cases, essential tools for hand polishers.

With the advent of composition applicators, the usual size bar composition was 12 in × 2 in × 2 in., but now 24 in. and 26 in. bars are used regularly. Another outcome of the trend towards larger bars, of course, is that much longer production runs are obtained, before the composition applicator

requires recharging with a fresh bar.

Greaseless compositions were used mainly in connection with satin finishing of non-ferrous articles such as brass, copper and zinc die-castings, etc. In recent years, however, new uses have been found for them. Light scurfing can be carried out with a mop dressed with greaseless composition.

The technique of dressing felt bobs with a thick layer of greaseless compositions has developed in recent years, particularly in the aircraft industry. These compositions are now available in silicon carbide as well as Aloxite (fused aluminium oxide), and special grades have been developed for stainless steel work.

Direct application of greaseless compositions to a calico mop was, and is, quite satisfactory for satin finishing, but if a substantially thick dressing were required, a lengthy process was necessary to obtain it. This led to the development of a special formulated bond, which can be applied to the mop before the greaseless composition is applied. The effect of this bond is that substantially thicker dressings of greaseless composition can be obtained on mop, felt bobs, etc., very quickly, and the cut of the abrasive is comparable to wheels dressed with a similar grit abrasive.

The success of sprayed liquid compositions is dependent upon many things, and not only on the type or quality of the liquid composition. If no serious thought has been given to the spray equipment, or method of application, or mop speed, then the finest liquid composition is useless. Similarly, the finest technique, and first class spray equipment will never make up for mediocre liquid composition. It is important to stress that the application of liquid compo must be regarded as a technique involving the compo, the equipment and the method of application.

Liquid polishing compositions fall into three main groups: (1) for buffing operations on non-ferrous metals; (2) for buffing operations on stainless steel and steel cutting compositions in general; and (3) for finishing operations.

The type most widely used is liquid tripoli composition and this can be applied to most non-ferrous buffing operations, such as brass, copper, zinc based diecastings, etc. Many claims have been made with regard to the performance and economy of liquid compositions compared with solid bar compositions, and these comparisons vary greatly. In many instances where liquid compositions are being used, the people concerned claim that it is not cheaper than using bar composition, but for other reasons they continue to use the liquid composition for the time being. Even in America, where a high proportion of automatic polishing machines are supposed to be equipped with liquid compositions, one large manufacturer who supplies both types of composition will claim by advertisement that solid bar composition is much cheaper to use than liquid composition, whilst another equally large producer of both types will claim that liquid composition is the cheaper.

Welding Aluminium and Its Alloys—*continued from page 340*

excessive bead or may result in burning through.

It is often impossible to weld thick plates satisfactorily from one side in one run and the joint is then made from each side in turn. The work is first tacked and welded from the side opposite the tacks. The underside is then chipped out to form a groove sufficiently deep to remove regions inadequately fused during the first run and the weld is completed by a run on this side. Full penetration may be possible without adopting this procedure but a double weld is valuable in reducing the risk of flux or slag inclusions.

Welding from both sides—simultaneously or in turn—can be done, without chipping from the back, using certain electrodes, for example, 14 S.W.G. on ⅛ in. material.

When the arc is broken, the coating tends to cover the tip of the electrode, thus obstructing the re-establishment of the arc. It is usually sufficient to tap the end of the electrode on the work to crack off this coating, but it may be necessary to cut off the tip.

Because of the high degree of fluidity characteristic of metal-arc welding, the tendency has been to favour downhand welding. However, vertical welding is possible with material thicker than $\frac{3}{16}$ in., although greater skill is required as there is a danger of burning holes in the plates.

The weld is started at the bottom, the arc kept as short as possible, and the current used is 10-15 per cent less than that appropriate for the horizontal position. The electrode is held at 90° to the plates and is moved with a slight weaving action. Some electrodes now available make positional welding more practicable and may even enable overhead welds to be made, but greater skill is required than for the downhand position.

The slag on a metal-arc weld should flake off readily, especially if the weld is allowed to cool before the slag is removed. Slag removal is easiest from butt welds and may even be self-lifting; otherwise it can be cleared away with a bristle-brush or by light chipping, and must, of course, be chipped off after each pass in multi-pass welding. Slag from some types of electrode is more difficult to remove and may necessitate heavier chipping. With either kind of electrode all traces of residual slag should finally be removed by scrubbing and, if necessary, washing.

It is important to note that the poorer the quality of the weld—the poorer its profile and the more crevices it contains—the more difficult becomes the removal of slag. From a well-shaped weld, slag can often be removed with a dry bristle-brush.

If the assembly is of convenient size and shape it may be immersed in very hot water and there washed and, if necessary, scrubbed—again with a bristle-brush for preference. Several brief washings are more effective than a single, prolonged one. Larger or more awkward assemblies should be scrubbed and rinsed under a stream of hot water. The final rinse should be at about 90°C. water temperature for 3 min.

Assemblies that provide angles or crevices for flux to be trapped may need further treatment. After one or two scrubbings and a rinse the assembly may be immersed for about 10 min. in a 5 per cent solution of nitric acid at about 70°C. Chemical treatment is followed by rinsing to remove acid, and it may then be advisable to check the effectiveness of the treatment. A small quantity of silver nitrate test solution, added to a sample of the wash water, will leave a white precipitate if any flux remains. After the final rinse, the assembly must be drained and dried as quickly as possible to avoid staining.

The impracticability of applying such treatment as this to a large assembly emphasizes the importance of eliminating flux traps at the design stage.

Acknowledgments are due to the Aluminium Development Association for information supplied on which this article is based.

Obituary

Mr. C. E. Prosser

It is with much regret that we record the death, at the age of 66, of Mr. Cyril Ernest Prosser, a former chairman of the Metals Division of Imperial Chemical Industries Ltd. Mr. Prosser joined Elliotts Metal Company in his youth and later became that company's sales manager. When Elliotts and British Copper Manufacturers Ltd. were merged with Kynochs Ltd., under I.C.I., he was appointed assistant sales manager of the combined metals department. He was appointed a delegate director in 1936, later becoming joint managing director, and finally chairman of the Metals Division. He retired in 1955 after 45 years with the group. Mr. Prosser, during his career, had been chairman of the Brass Wire Association, The Brass and Copper Tube Association, and the Manufactured Copper Association. During the Second World War he was chairman of the Government panel co-ordinating supplies of non-ferrous tubes and shell bands.

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Improving Oil Firing Efficiency

IN tests conducted at the Laboratoire National d'Essais, Paris, it has been shown that control of sulphur from liquid fuel firing can be achieved by use of an inhibitor manufactured by Combustion Chemicals Ltd. When added to residual fuel oils at 1 part per 1,000, Desulfurol sulphur inhibitor also improves certain qualities of the fuel oil, CO_2 levels and steam output are substantially increased, and flame temperatures are appreciably higher.

In these tests, carried out on a Babcock and Wilcox boiler, the steam output was increased from 1,934 lb/hr. to 2,067 lb/hr., the CO_2 percentage from 10·8 to 12·8 and the flame temperature from 2,444°F. to 2,506°F. at 30 cm. from the burner tip.

The control of sulphur exercised by the introduction of Desulfurol to the fuel oil in the storage tank leads to a substantial reduction in the build-up of sulphate scale and acidic soot deposits in boiler operation, and in sulphur fumes and sulphur contamination in furnace installations.

Speeding Assembly of Small Components

FOR storing large quantities of small components and dispensing them in correct assembly sequence to a point only a few inches from the assembly area, a new rotary storage and dispensing machine, known as the Rotasembler, developed and manufactured by Work Study Equipments, has made its first appearance at Regentone Radio & Television Ltd.. It eliminates complicated identification of parts by the operator and greatly reduces the amount of space required to store quantities of many types of components. The indexing mechanism is compressed air operated by Maxam pneumatic control equipment manufactured by Maxam Power Ltd., one of the companies of the Holman Group.

At Regentone, twenty Rotasemblers store and dispense small electrical components such as resistors and capacitors used in the production of printed circuit radio and television receivers. These units replace fixed part layouts of bins arranged around the operators and they have already resulted in considerable labour and space savings, and in a 40 per cent efficiency improvement in the assembly section where they are in use.

Despite its extremely compact appearance (28 in. circumference and 26 in. high) the Rotasembler is capable of storing up to 38 different components in 19 vertically divided hopper units. Each of these 38 hoppers can store as many as 2,000 small components. The hoppers are mounted on two support rings attached to a centre shaft which is driven by a simple indexing mechanism. This mechanism comprises a chain-driven ratchet gear operated by a Maxam 1½ in. bore, 2 in. stroke double acting air cylinder and a small brake assembly. A Maxam foot valve controls the movements of the air cylinder and brake which, in turn, controls the indexing movements of the hoppers.

High Speed Milling for Hard Metals

A MILLING process that combines the high speeds of routing with the mechanical feeds, cutting pressures and solid fixturing of standard milling practice, plus climb cutting, carbide-brazed cutting tools and liquid carbon dioxide cooling on both cutter and point of machining, has potential applications for machining ultra-hard, thermal resistant metals.

The new milling process was developed by the Boeing

Left: Three Maxam Rotasembler units for storing and dispensing small components at Regentone Radio and Television Ltd.

Below: High speed milling by the process developed by Boeing for stainless steel

Airplane Company, Seattle, Washington, U.S.A., for trimming Armco PH 15-7 Mo stainless steel alloy.

A standard knee-milling unit equipped with a high-speed routing head was used. Cutter speeds as high as 7,000 r.p.m. and feed rates up to 180 in/min. were achieved. As much as 60 linear feet of annealed 0·125 in. PH 15-7 Mo, with tensile strength of 130,000 lb/in^2 were test trimmed in a matter of minutes before tool failure.

The new process is expected to increase production rates a hundredfold, with similar significant increases in tool life. New areas of application in machining the "unmachinable" new steels, nickel-base and cobalt alloys and other metals designed to withstand the high temperatures of hypersonic flight will be explored. Tests in the immediate future will determine maximum and minimum thickness that can be milled and how deep a cut may be taken. PH 15-7 Mo sheets heat-treated to tensile strengths up to 220,000 lb/in^2 are being evaluated. Both numerically-controlled and hydraulically-controlled profile mills may be adapted to use the new process.

Sheet Sorting and Stacking

PARTICULARLY suitable for handling tin plate, a high-speed fully-automatic plant for sorting and stacking sheets has been developed by Schloemann Aktiengesellschaft, of Düsseldorf. This type of equipment is of special value in rolling mills and tinning plants where production of thin, flat products is nowadays so large that the conventional finishing line equipment is no longer able to cope with either the amount or the variety of the output.

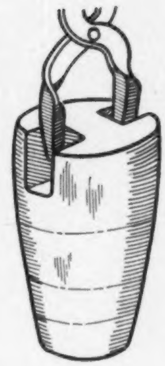
Upon entering the plant, the gauge strip is first cut into sheets, which are transferred by conveyor belt to the sorting belt. Faulty sheets are thrown off at either of two sorting stations, depending on the type of defect; perfect sheets proceed to the end of the sorting belt. The plant is designed to operate dependably, even at maximum speed, without damaging the surface of the material handled.

A fully-automatic sorting and stacking plant of this kind for dealing with electrolytic tinned sheet in lengths of 14 in. to 59 in. has recently been supplied. This plant operates at a maximum speed of 1,300 ft/min.

Shaped Ingots Reduce Melting Losses

THE total surface area of the ingots in a charge is considerably greater than that of an equivalent charge concentrated in one mass; the same applies to scrap but in a much greater degree. Losses in melting can be shown to be directly proportional to the surface area of the charge.

To lessen this loss the Centre Technique des Industries de la Fonderie has developed and patented a shaped ingot having exactly the same shape as the interior of a crucible. The surface area of such an ingot is one-third that of an ordinary ingot charge of the same weight and one-tenth that of an equivalent scrap (runners, risers, etc.) charge.



It is claimed that laboratory and industrial tests using the shaped ingot have shown that the melting loss by oxidation in copper-base alloys is more than halved. This reduction in melting loss gives savings of between ½d.-¾d. per lb. of metal cast, the lower figure applying to those foundries whose melting practice is the most efficient.

High Vacuum Furnace for Modulus Measurements

EQUIPMENT designed for the measurement of Young's Modulus for a number of metals at temperatures up to at least 1,000°C. in high vacuum has recently been made at Vacuum Research (Cambridge) Limited for Imperial Chemical Industries Limited, Witton, Birmingham, to their design.

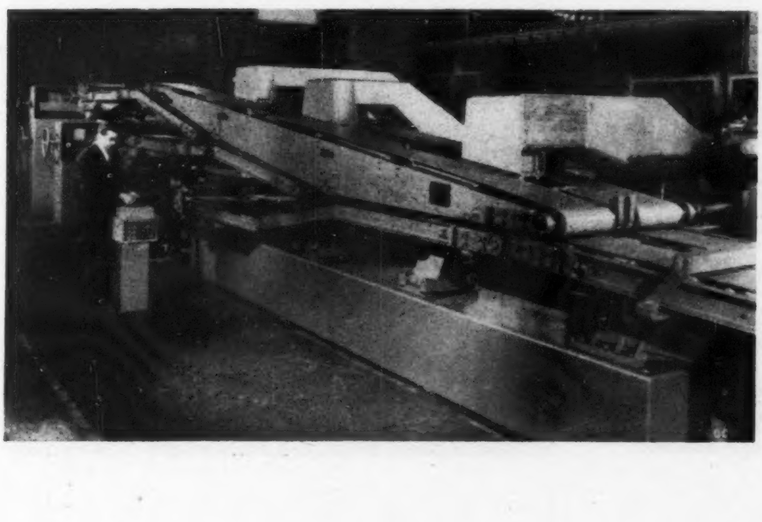
The interior of the water-cooled vacuum chamber contains two molybdenum-wound furnaces which heat the specimen in a working vacuum of 10^{-5} mm. Hg. The high vacuum prevents oxidation of the metal specimen at elevated temperatures.

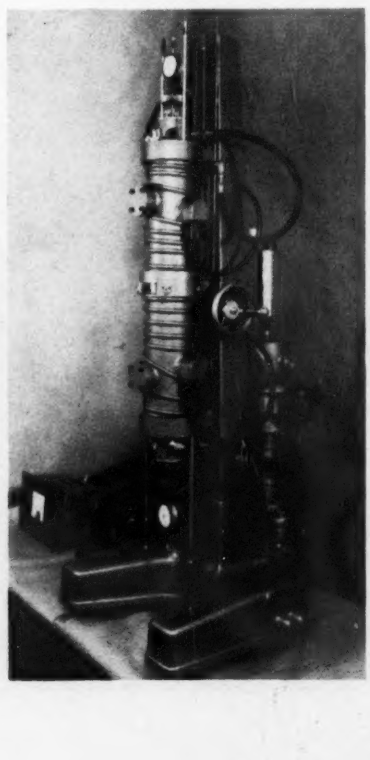
The high precision mechanism seen on the top and bottom of the furnace chamber are used to control the special electrodes, inside the furnace, which are required in the acoustic method of Young's Modulus measurement using an electrostatic drive.

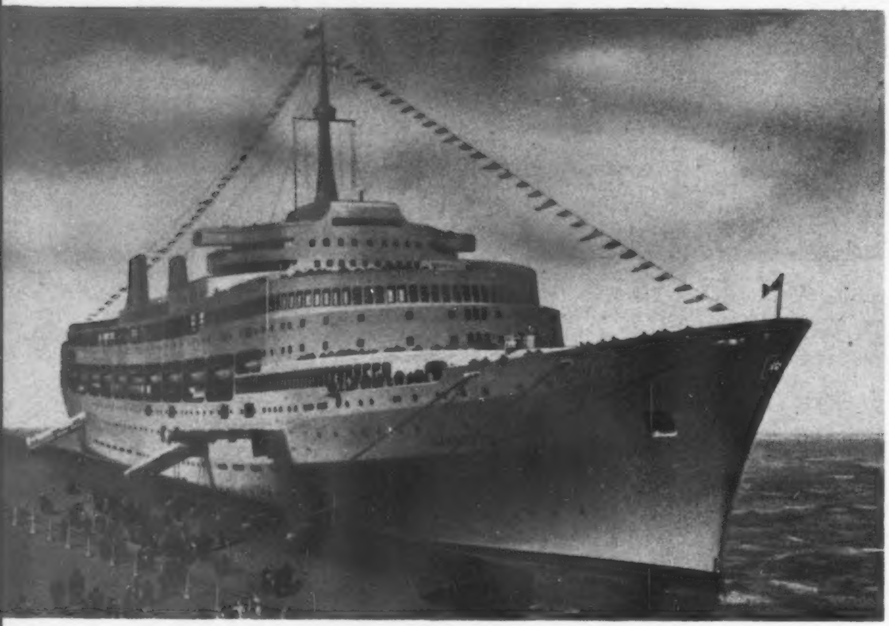
Special techniques are incorporated in the design and construction of this apparatus to ensure a vacuum tightness of the various joints which are broken to allow insertion of the specimen and electrodes. The leak rate of the furnace at 1,200°C. is less than one clusec, which is good for this class of apparatus.

Right: Apparatus for measuring Young's modulus at temperatures up to 1,000°C. in high vacuum

Below: Schloemann sorting and stacking plant for electrolytic tinned sheet







Aluminium in "Canberra"

CONSTRUCTIONAL work on *Canberra*, the 45,000 ton passenger liner which Harland and Wolff are building in their Belfast yard for the P. and O. S.N. Co., is now well advanced. The vessel is due to be launched on March 1, 1960, and among the many novel features incorporated in her construction, the all-welded aluminium superstructure plays an important part. The provision of maximum accommodation within the restricted dimensions of a ship is the aim of any ship's designer, and it was realized that by using aluminium for the superstructure of *Canberra* another deck could be incorporated and many more passengers accommodated. The additional accommodation completely offset the additional cost of this more expensive material. It was finally decided that *Canberra* should have a fully welded aluminium superstructure and, in fact, more than 1,000 tons of this material are being used. *Canberra* will therefore have the biggest all-welded aluminium ship's superstructure built to date.

On her voyages to Australia and the Pacific, this ship will be sailing through the Suez Canal, and this imposes certain limitations on her size. The use of aluminium in her superstructure has saved about 1,500 tons of structural weight and this has enabled two or three hundred more passengers to be carried. There are four tiers of passenger accommodation in the superstructure, above which there are another four tiers of bridge decks. The twin funnels and the mast will also be made of aluminium.

Nearly 800 tons of plates and extruded sections, all in BA.28 alloy, manufactured to Lloyd's Lists and requirements, have already been supplied by the British Aluminium Co. Ltd. The aluminium is being entirely welded. Panels of deck plating and deckhouse sides are prefabricated in the welding shops by the Sigma inert-gas metal-arc process, using both automatic gantry and manually-operated machines. The gantries have been specially designed and built by Quasi-Arc Ltd. for this class of work. The deck panels are up to 30 ft. square and are complete with deckbeams, ready for erection on board, where they are welded to neighbouring panels.

The deep deck girders are also prefabricated from plate webs and heavy bottom flanges, cut from plate or extruded sections. This method of manufacture gives the designer an unlimited choice of strength properties for each length of girder, which could only be matched in extruded sections by making a large number of costly dies—dies, moreover, which would be amongst the largest used by the aluminium industry.

Before building *Canberra's* superstructure, Harland & Wolff Ltd. invited the co-operation of the British Aluminium Company in the design and construction, at Belfast, of a representative portion of a ship's superstructure. This provided practical experience of making many of the welded joints likely to be employed on the ship and confirmed that the shipbuilders' design proposals were well suited to the material and the scope of the forthcoming work on the ship.

Some of the plates delivered have been welded at the British Aluminium Company's rolling mills at Falkirk, where plates up to 14 ft. wide may be made by automatically welding together two 7 ft. wide components. Seven feet is the maximum width of plate which can be hot rolled, but greater widths are often preferred by shipbuilders since the 'tween deck height is seldom less than 7 ft. 6 in. With the welding bead removed this welded plate is virtually indistinguishable from unwelded plate.

Above: The "Canberra" as she will appear when completed

Right: Construction of the all-welded aluminium superstructure; the forward end on the promenade deck

VERTICAL TUBE PRESS INSTALLATION AT TONKS (B'HAM) LTD.

Extruding High-Grade Tube Shells

INSTALLATIONS which include a new vertical tube extrusion press and ancillary equipment in the tube mill of Messrs. Tonks (Birmingham) Limited have initiated an overall modernization of that section of their works. This company have, for many years, operated their tube mill as an adjunct to their role of manufacturers of high class builders' and architectural brassfoundry, and the introduction of the new plant represents a notably progressive step, as they have not previously produced tube shells.

Within a very short period after its installation, production was flowing steadily from the press, and the quality of the tube shells was meeting the fairly stringent requirements of the company's products.

The tube mill output falls largely into two groups: (a) tubes for use in their own factory for subsequent conversion into component parts in a wide range of builders' hardware and architectural metal work, and (b) tubes for customer's requirements in other various trades.

These products call for a fairly wide variety of alloys, and as tube drawers to the trade, the firm draws, and now also extrudes from the billet, most of the copper alloys. Batch production of special purpose tubes is also undertaken. The common range of alloys covers then, 85:15 and 70:30 brass, leaded brass, arsenical and non-arsenical copper, 2 per cent aluminium brass for condenser tubes, as well as copper for radiator applications, and certain other special alloys.

Outlets for these tubes arise largely in the plumbing, motor, and electrical industries, although there are few trades where some applications do not exist.

Extrusion Press Installation

The new press, built by Fielding and Platt Ltd., is of 1,000 tons capacity, one of the main features being that the minimum space has been occupied—a vital factor in a works where production capacity is largely limited by available floor space. A second, though not less important characteristic of the vertical press, is that it has permitted the company to achieve better finish and greater accuracy on tube shells.

As with most installations of this type, the press is mounted on a platform raised some 9 ft. 6 in. above the floor of the shop. The platform also carries the billet heating furnace and control equipment.

Billets themselves are bored in a vertical drilling machine and have the outside diameter skimmed—a practice that improves concentricity and removes surface defects. They are then placed on a chain lift, which carries them up to the platform and delivers them upon the entry table of the billet heating furnace, which is also part of the new installation. Here they are manually fed into the furnace chamber, a sloping hearth providing the means of conveyance through the furnace. Furnace temperature varies somewhat according to the alloys being extruded, but is usually around 780°-800°C.

The press has been designed for a production rate of 80 shells/hr., and the range varies from $1\frac{3}{8}$ in. to $2\frac{5}{8}$ in. diameter.

A team of three normally operates the press, and the extrusion technique used leaves behind a thin "canister" some 0·008-0·010 in. in thickness. Although this involves further metal loss and hence higher production cost, the company considers this is amply justified by the better finish and freedom from inclusions obtained.

The press itself is one of the latest of its kind, designed expressly for the production of thin walled tubing from brass or copper. Operating on the indirect extrusion method, provision is also made to enable direct extrusion to be carried out if required.

Extruding copper tube shells on the Fielding and Platt 1,000 ton vertical tube extrusion press at Tonks (Birmingham) Ltd. The furnace can be seen behind the press, the control panel being on the right

At ground floor level, tubes fall from the press into a quench tank. The liquid level control indicators, the pumping unit, and the billet lift can all be seen to the right of the quench tank

The press frame is of cast steel integral with which is the main cylinder. The main ram is of the single acting downstroking type; the return stroke being carried out by two drawback assemblies of the fixed ram moving cylinder type.

The press motions are controlled by a hand lever-operated valve. To ensure a rapid main ram approach stroke a pre-filling system operating at a pressure of 80-100 lb/in² is included in the hydraulic circuit.

The container is guided on the drawback rams and is supported when the main ram is in the up position by two constant pressure ram assemblies. To ensure accurate alignment between the drawback rams and container, gunmetal guide bushes are fitted.

The hydraulic pressure medium for press operation is provided by a Fielding air/hydraulic accumulator system which incorporates an electronic liquid level control. The accumulator is charged by two Fielding type H.3 totally enclosed three-throw, reciprocating pumps, each driven by a 115 h.p. electric motor.

Suction trips are fitted to each of the pump suction valves, these function in the same manner as by-pass valves to control the delivery of the pumps. The trips are actuated by the water level in the accumulator acting on the electrodes of the liquid level control.

The press is fitted with a Fielding swing type parting-off saw which is mounted on the press frame. The saw is driven by a 5 h.p. flange motor and operates at a speed of 720 r.p.m. The drive between the motor and blade is made through the medium of spiral bevel gears. A guard is fitted to the saw, which moves into position over the blade as it is swung clear of the press. The saw is automatically started and stopped by means of an electrical limit switch that is arranged to operate as the saw is moved in to the "in" or "out" position.

Leading particulars appertaining to the press are as follows: Main ram power, 1,000 tons. Stroke of main ram, 28 in. Billet size, 5 in. diameter × 10 in. long. Container size, 5⅛ in. bore × 12½ in. long. Hydraulic medium, water. Hydraulic working pressure, 3,000 lb/in².

STANDARD SPECIFICATIONS

Aluminium - Copper - Magnesium - Silicon - Manganese Alloy Bars and Extruded Sections. (Solution Treated and Aged at Room Temperature.) 2L.64 : 1959. *Aluminium - Copper - Magnesium-Silicon-Manganese Alloy Bars and Extruded Sections. (Solution Treated and Precipitation Treated.)* 2L.65 : 1959. *Price 2s. 6d. each.*

THESE revised standards ("aircraft series") result from a recommendation that, because of the differing extrusion and forging production practices, British Standards L.64 and L.65 should relate only to bars and extruded stock and that separate British Standards be published for forgings and forging stock of this alloy.

British Standards L.76 and L.77, which replace British Standards L.64 and L.65 with respect to forgings and forging stock, were recently published. British Standards 2L.64 and 2L.65, in consequence, only relate to bars for machining and extruded stock.

Copies of the above - mentioned standards may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Men and Metals

Within their sales organization the following appointments have recently been made by the Alloys Division of Union Carbide Limited:—**Mr. Colin Dunger** to be assistant sales manager, **Mr. William Smith** to be area sales manager in Scotland, and **Mr. William Paton** takes charge of the sales department's Birmingham area.

It is reported that **Field-Marshal Sir Gerald Templer** and **Sir Harry Greenfield** have been appointed directors of the Amalgamated Metal Corporation.

Reports from The Northern Aluminium Company Ltd. are to the effect that **Mr. C. P. Paton** has resigned from the board to take up a position with Aluminium Limited of Canada. He is succeeded by **Mr. Taylor Cornelius,** who has taken over the position of general works manager of Northern Aluminium and has been elected a director of that company.

Previous head of the Fatigue Department at Bristol Aircraft Company, of Filton, **Mr. Tibor Haas,** Dipl.Ing., A.M.I.Mech.E., A.F.R.Ae.S., has been appointed head of the design section in the newly-formed members' service department of the British Welding Research Association at Abington.

Recently appointed sales manager of Electropol Processing Limited, **Lieut.-Cmdr. Douglas F. Battison,** R.N. (Retd.), studied metallurgy at Sheffield University prior to entry into the Royal Navy in 1941, where he served as a regular officer until 1959.

It has been announced by Sciaky Electric Welding Machines Limited that **Mr. V. C. Cadle** has now assumed responsibility for sales in their northern area. Mr. Cadle, who has been with the company for 16 years, has worked in each of the company's technical departments, and was until recently service supervisor for the same area.

The following appointment has been made by London University: **Mr. A. V. Bradshaw,** B.Sc., Lecturer in Metallurgy at the Imperial College of Science and Technology, to the University Readership in Extraction Metallurgy tenable at that college.

On Monday next the new President of the Institute of Metal Finishing, **Mr. A. A. B. Harvey,** M.Sc., F.R.I.C., Barrister-at-Law, will be inducted into office for the forthcoming year of the Institute. Mr. Harvey took an honours degree in chemistry at Queen Mary College, London University, in 1933, and subsequently received his degree of M.Sc. His first appointment was in the laboratories of Alfred Holt Ltd. Later he was chief chemist of Briggs Motor Bodies Ltd., followed by a period at Vauxhall Motors Ltd. Since 1958 he has been director of technical services at Sunbeam Anti-Corrosives Limited.

Industrial News *Home and Overseas*

Sale of Zinc

It was announced by the Board of Trade on Thursday last that they have decided to sell 3,000 tons g.o.b. zinc from their trading stocks. These sales will be made to the agents of the original supplier for delivery in November.

New Head Offices

It is understood that **The British Oxygen Company Ltd.** have completed arrangements to lease a large modern office building for their head office, near Hammersmith. Construction will start soon, and it is expected that the move from the present premises in St. James's, London, will take place in two or three years' time.

A Mexican Aluminium Smelter

Plans to build Mexico's first primary aluminium smelter, scheduled to yield its initial metal in two years, have been announced by Intercontinental, S.A., a Mexican investment bank, and the Aluminum Company of America. The plant will have capacity to produce 20,000 metric tons of aluminium a year. It will be located in the State of Veracruz, on a site which can be served by ocean-going barges. Nearly 20,000,000 dollars will be spent on the project.

A new company called Aluminio, S.A., has been formed. Alcoa will have a 35 per cent interest in Aluminio, European investors will own 10 per cent, and the remaining 55 per cent will be held by Intercontinental and other Mexican investors.

Further Expansion

Shortly after establishing a Scottish office, **West Instruments Ltd.** have now extended their sales and service coverage by opening a Newcastle office. Appointed as manager of this new office is Mr. W. I. McNall, B.Sc., who has had considerable experience in instrumentation and, in particular, of temperature control systems.

Air Impellers

As a result of an agreement between **S. Smith and Sons (England) Ltd.** and the **Torrington Manufacturing Company,** of Connecticut, U.S.A., a newly-formed department of the Smiths organization will manufacture Torrington air impellers and market them throughout the world, with the exception of the Americas.

The British company's products will be known as the Smith's Torrington air impellers, and the new department will provide fans for a wide variety of industrial and domestic uses, ranging from air conditioners, refrigerators and electronic cooling equipment to house warming units.

Contract from Germany

News from **Baker Perkins Ltd.** is that the company has received a contract for the supply of foundry equipment to the German founders, Elektro Geratebau, of Oberderdin. The British firm will supply a completely automatic moulding line to work in conjunction with two 24 in. by 24 in. Taccone diaphragm moulding machines. The plant will be capable of 150 moulds per hour, and will include indexing mechanisms, roll-over and lowering devices, a closing device, automatic box separation, and powered conveyor lines.

New Central Showroom

Created to form part of a large-scale information programme which **S. Smith and Sons (England) Ltd.** has recently instituted a new central showroom, known as the Smith's Centre, was opened last week by **H.R.H. The Prince Philip, Duke of Edinburgh.** The Centre is situated on the ground floor of the headquarters building of the company at Cricklewood, London, N.W. It occupies an area of 4,000 ft^2, and has been designed to show a selected range of products from every side of the business, grouped in their specific industries or applications.

The contribution of the Kelvin Hughes company to one of these sections comprises examples of instrumentation for three diverse technological fields—non-destructive testing of materials, high-speed recording of transient phenomena and automatic control of shell boilers.

The Centre also provides an historical panorama of the growth of the organization, together with a broad detail of the "Things Smiths Make" in their many factories, some twenty in all, spread in various parts of England, Scotland and Wales. A fully-equipped projection box spans the central section of the Centre, and seating accommodation is readily available for sales conferences, receptions, demonstrations, and other similar functions. A permanent exhibition will be maintained, providing up-to-date products of the group and special displays of the activities of the companies within the group.

Copper Roofing

A new publication has recently been issued by the **Copper Development Association** which deals with the advantages copper has to offer as a roofing material. Whilst the two main forms of copper roofing methods—traditional and long strip—are described, the subject of preformed roofing is also included.

In addition to its use for weathering, other applications of copper sheet and strip in building, such as rainwater goods, lightning conductors, and damp-proof courses, are also described. Another feature of this new publication is the large number of pages devoted to drawings, illustrations and specifications of each detail and aspect likely to be involved in the laying of all types of copper roofing.

Nickel in Russia

According to reports in the Soviet news agency *Tass*, a new deposit of nickel ores with a high nickel content has been discovered near the town of Serov, in the Urals.

Indian Import Licences

It is reported from Bombay that the Government of India has decided to issue licences for the import of copper and zinc ingots on weight basis against export of brass semis.

A trade notice issued by the Joint Chief Controller of Imports and Exports at Bombay said: "The registered manufacturer-cum-exporter shall undertake to export within six months of the importation of the licensed articles, finished brass goods equal to one ton in weight for every 1·05 tons of material licensed under this scheme. Out of this total of 1·05 tons, a maximum of up to 70 per cent in weight may be permitted for copper ingots and the balance for zinc ingots."

Nickel Deposits in Dominica

It is understood that a pilot plant for extracting nickel deposits in the Cibao region, Dominican Republic, is to be set up by the **Falconbridge Nickel Company's** Dominican subsidiary in the next six months. Within two years, large-scale production is planned, which will employ five to six hundred workers. Surveys conducted in the area indicate that deposits of ore in the Cibao area total 100 million tons.

Soviet Welding Methods

What is claimed to be the world's largest installation for the welding by electronic beam of tungsten, tantalum, molybdenum, niobium, and other refractory metals and alloys, is being built in Kiev at the Paton Electric Welding Institute of the Ukranian Academy of Sciences.

The Soviet news agency *Tass*, reporting this, said electrons emitted by an incandescent tungsten spiral were focused on a small area of the metal to be welded making it melt. Welding was effected by a comparatively low-power current at high tension in a vacuum. Experiments already carried out at a less-powerful installation had proved the high degree of efficiency of the new process, *Tass* said.

World Tin

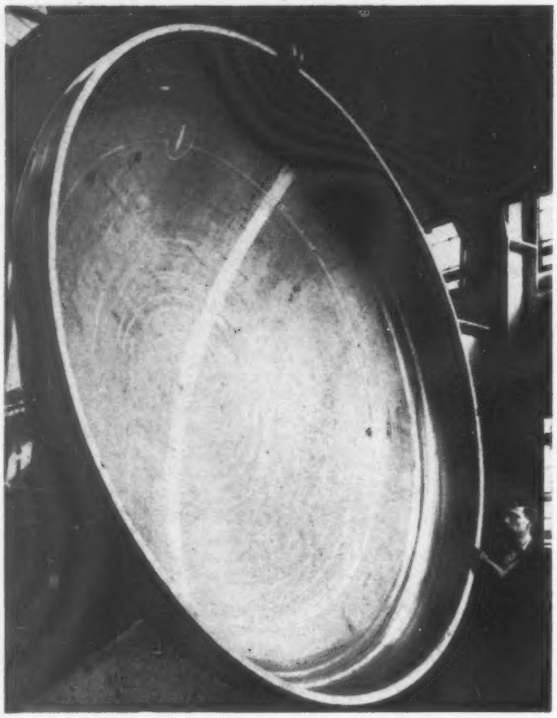
Mine production of tin-in-concentrates increased during September in Indonesia (1,809 tons) and Thailand (845 tons). Output in the Federation of Malaya, at 3,039 tons, was little changed from the previous month, according to the International Tin Council.

Exports of tin-in-concentrates from Bolivia (including tin designed for the U.S.A. Commodity Credit Corporation as the result of barter deals) rose sharply in September to 3,308 tons. Exports during September from Nigeria (254 tons) and Indonesia (491 tons) were relatively small. 806 tons of tin-in-concentrates were exported from the Belgian Congo in July.

Imports of tin-in-concentrates into the United Kingdom in October (including some tonnages destined for the U.S.A. Commodity Credit Corporation) amounted to 2,004 tons. Imports into the Netherlands in September, at 1,558 tons, were again relatively high. 760 tons of tin-in-concentrates were imported into the Federation of Malaya and Singapore in October.

Exports of tin metal from the Federation of Malaya and Singapore in September fell to 3,288 tons. Exports from the Netherlands in the same month rose to 1,232 tons.

Imports of tin metal into Federal Germany were again at a high level in August, when they amounted to 1,555 tons. In September, imports into Denmark (993 tons), France (889 tons) and the Netherlands (820 tons) all showed an increase over the previous month. Imports into Japan fell to 515 tons in July but recovered to 735 tons in August.



Aluminium spun ends by G. A. Harvey and Co. (London) Ltd.

Aluminium Spun Ends

What are believed to be the largest spun aluminium ends produced in this country, have recently been delivered by **G. A. Harvey and Co. (London) Ltd.** These "Rotarprest" aluminium ends (one of which is illustrated on this page) have an inside diameter of 10 ft. and are $1\frac{3}{8}$ in. thick. Each end was spun from two plates (B.A. 28-N.P. 5/6) butt welded to form a flat disc 12 ft. in diameter.

These ends are for pressure vessels, which will contain liquid air.

Institute of Metal Finishing

On Monday next, November 30, at the Charing Cross Hotel, London, W.C.2, the annual general meeting of the Institute of Metal Finishing will be held. At this meeting the new President, Mr. A. A. B. Harvey, M.Sc., F.R.I.C., will be inducted into office by the outgoing president, Dr. T. P. Hoar.

The meeting will begin at 11 a.m. and after the luncheon interval will resume at 2.45 p.m. to hear the new President deliver his address.

Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week rose by 579 to 7,710 tons, comprising London 4,294, Liverpool 3,221 and Hull 195 tons.

Copper stocks rose by 44 to 6,852 tons and were distributed as follows: London 1,474, Liverpool 3,628, Birmingham 75, Manchester 1,575, and Hull 100 tons.

New Offices

A new district office is to be opened on Tuesday next in Bristol by **The Consolidated Pneumatic Tool Co. Ltd.** This office will be under the management of Mr. J. D. Glover and is located at 1 Bedminster Down Road, Bristol. Its operations will cover the counties of Somerset, Devon, Cornwall and part of Gloucester.

The company's branch office at Bridgend, Glam., which previously served the above area will continue to operate as the South Western District for the South Wales counties, Hereford and part of Gloucester.

Trade with Guatemala

A Guatemalan Government Order was published recently which prohibited all imports of lead into the country except in the event of a shortage on the national market, when the Ministry of Economy may authorize imports in cases of emergency only.

Long Service Awards

A special dinner has been arranged at the Grand Hotel, Birmingham, on Tuesday, December 8 next, by **Elkington and Co. Ltd.** to mark the occasion of the presentation of gold watches to 52 employees each with over 25 years' service.

The 52 employees concerned have a combined total of almost 2,000 years' service and four of these together have attained 209 years service. The presentations will be made by Mr. W. E. Ogden, M.C., F.C.A., chairman, and Mr. W. W. Dolton, managing director, both of the Delta group of companies, of which Elkington is one.

Costing

In the belief that there are many manufacturers of light springs who would welcome guidance on simple methods of costing, the **Light Spring Association** appointed a Committee of Accountants to study the matter and make recommendations. The result of the committee's work has now been published as a booklet entitled "Simple Costing for Light Springs", outlining a practical approach to costing which should prove particularly attractive to the small manufacturer who has little knowledge of the subject. Copies of the booklet may be obtained from the secretaries of the association, 301 Glossop Road, Sheffield 10, at 2s. 6d. each, post free.

Metal Finishing Meetings

Two meetings of interest are being held by branches of the **Institute of Metal Finishing** next week. The Midland branch is meeting on Tuesday next, December 1, at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 6.30 p.m., when Mr. K. B. Glassby will give an address on "Work Study in the Metal Finishing Industry".

The North-West branch is meeting on Thursday next, December 3, at the Engineers' Club, Manchester, at 7.30 p.m. At this meeting, Mr. A. W. Slater will talk on "Embrittlement in Plating".

Visitors from France

Fifteen members of the French Institute of Welding visited the **A.P.V. Company's** factory in Crawley recently, during their attendance at the Autumn meeting of the Institute of Welding in London. On arrival at Crawley, the visitors were welcomed by Dr. Richard Seligman, President of the company, and they then made a tour of the engineering works, fabrication shops, foundries and laboratories.

Silicon Manufacture

Earlier this year **Imperial Chemical Industries Limited** announced the bulk production of semi-conductor grades of silicon from their plant—the first in Britain—and it was stated there were plans for expanding the capacity still further to 4,000 lb. The company states that its faith in the future of silicon has been well justified. The extension has been completed, and the benefit of increased production is being passed on to the consumers by way of price reductions. The demand for silicon in Britain can be met, and considerable quantities are being sold abroad, so that extensions have been planned which will more than double capacity in 1960. These modifications will be made relatively simply, as the original plant was designed for ready expansion.

Two distinct types of silicon are required at present by device manufacturers—lump or granular silicon, from which single crystals are made, and zone-refined silicon in rod form Lump silicon (150-500 ohm. cm. p-type) is the form that I.C.I. have been marketing successfully so far.

I.C.I. have been actively working on methods of growing silicon rods suitable for zone-refining, and are now installing a new plant which will be producing polycrystalline rods early in 1960. The rods will have diameters up to 1 in. and lengths up to 24 in. They will have a smooth surface finish and this, together with their very small variations in physical dimensions, will enable them to be used without further processing in zone-refining equipment. It will be possible to obtain high quality single-crystal rods after a few passes in the zone-refiner. The company is continuing active research in close co-operation with device manufacturers, both at home and abroad, in order to keep abreast of new developments.

Change of Name

It has been announced by Birlec Limited that, with effect from January 1 next, the name of the company will be changed to **A.E.I.-Birlec Limited.** This

change coincides with the final reorganization of the structure of the parent company, Associated Electrical Industries Limited, in several product divisions.

The internal organization of Birlec will not be affected, and the name of its associate company, Birlec-Efco (Melting) Limited, will not be changed.

Working Hours

News from the **Star Aluminium Co. Ltd.**, of Wolverhampton, is to the effect that the directors of that company have announced a reduction in the working week from 44 to 42 hr. for the same remuneration, to all employees covered by engineering agreements. This will take effect from January 1 next, by which time detailed arrangements will be completed with the appropriate trade unions.

This step coincides with the company's 25th anniversary celebrations. During the past year the company has presented watches and clocks to 28 employees who have completed 25 years' service.

Molybdenized Silicone Grease

Approval has been given to Molysil 33, the molybdenized silicone grease manufactured by **Rocol Limited,** by the Ministry of Supply under the specification D.T.D. 900/4630.

Molysil 33 grease is a lubricant for precision ball bearings and actuator gear boxes, and consists of molybdenum disulphide in a silicone grease vehicle. It has many applications in aviation, precision engineering, and the scientific field.

New Scottish Office

With the opening of a new branch office in Edinburgh, **Firth Cleveland Finance Ltd.** extends its hire purchase services to industry north of the border. The new offices are at Prudential Chambers, St. Andrew Square, Edinburgh, 2.

Imported Machine Tools

From Wednesday last, the import duty on machine tools was reduced from 17½ per cent to 10 per cent *ad valorem*, and the system of refunding the duty in certain cases is brought to an end. This was announced in the House of Commons on Tuesday last by the President of the Board of Trade, Mr Reginald Maudling, in a written reply to a question put down by a member.

The Import Duties Order dealing with this reduction concerns machine tools covered by tariff heading 84.45 (B).

Peruvian Copper Exports

In its fortnightly review, the Bank of London and South America states that the first exports of copper bars from the mines at Toquepala, Peru, are expected to be made in January 1960. Installations in the mine, the smelting plant, and the port of Ilo are almost complete. The Southern Peruvian Copper Company has invested 240,000,000 dollars in the various projects, of which 115,000,000 dollars was provided by the Export-Import Bank.

The mines contain an estimated 1,000,000,000 tons of copper with an ore content of 1.1 per cent, and are being worked by the open cast method, the report says.

Tube Milling Machine

An entirely new machine in the range of tube manipulating equipment is described in leaflets issued by **The Addison Tool Co. Ltd.** The "Fresatubi" multi-purpose tube milling machine has been designed to meet the demand created by the increasing use of tubes in the furniture industry. It consists fundamentally of a two- or four-speed headstock, a screw-operated cross slide, and attachment for fast infeed fitted with standard compound slide, on which is mounted a specially designed cam-operated tube vice. The machine can also be used as a 4 in. swing lathe by fitting a special chuck on the headstock, and the compound slide can be fitted with a four-way tool post. Alternatively, a saw spindle to take an H.S.S. blade is also available as an accessory.

Theft of Metal

Information has been forwarded by the Secretary of the **National Association of Non-Ferrous Scrap Metal Merchants** regarding the theft of the following metal in Wandsworth, London, between 3 p.m. on November 19 and 1 a.m. on the following day. The stolen property includes:

Four-wheel 10 ton Thames Trader, colour maroon/grey, registration XXF417. Seven bales paper-covered electrolytic copper cable core.

Any person able to give any assistance as regards this theft is asked to communicate with Mr. Francis, of Rhondda Metal Co. Ltd., 1 Hay Hill, Berkeley Square, London, W.1, telephone Mayfair 4654.

Pulse

The first number of a new house journal with the above title has just been published by **Kelvin and Hughes (Industrial) Ltd.,** its purpose being to provide at regular intervals information on the company's non-destructive testing equipment and electronic instrumentation.

In this first number there are several interesting articles, including one on ultrasonic butt weld testing and another dealing with investigations into the welding of rare metals in which an experiment recently carried out at the Battersea College of Technology, where Kelvin Hughes high speed pen recorders were employed, is described. The first of a series of four articles on the subject of high speed pen recording equipment is also included.

There are many diagrams and photographs accompanying the various articles.

Industrial Management

At the meeting of the **Tyne-Wear Metallurgical Association,** to be held on December 8, Mr. E. E. Watkin, M.A., will give an address on "Industrial Management". The meeting will commence at 6.30 p.m in the Lecture Theatre, Metallurgy Department, King's College, Newcastle.

Forthcoming Meetings

November 30—Institute of Metal Finishing. Charing Cross Hotel, London. Annual General Meeting. Presidential Address. A. A. B. Harvey. (Details to be given later.)

December 1—Institute of Metal Finishing. Midland Branch. James Watt Memorial Institute, Great Charles Street, Birmingham. "Work Study in the Metal Finishing Industry." K. B. Glassby. 6.30 p.m.

December 1—Institute of Metals. Oxford Local Section. Cadena Café, Cornmarket Street, Oxford. "Properties and Applications of Semi-Conductor Devices." H. M. Ettinger. 7 p.m.

December 2 — Institution of Plant Engineers. Southern Branch. Wm. R. Selwood Ltd., Plant Depot, Chandler's Ford. A practical demonstration of low temperature welding methods, followed by discussion. 7 p.m.

December 2—Institution of Production Engineers. Nottingham Branch. The Reform Club, Victoria Street, Nottingham. "Productivity from the Barrel—A Review of Surface Processing by the Barrelling Technique." H. D. Ward. 7 p.m.

December 3—Institute of Metals. Joint Meeting with the Bristol Section of the Society of Chemical Industry. Department of Chemistry, The University, Woodland Road, Bristol. "Beryllium Metal: Production Properties and Applications." Dr. G. A Wolstenholme.

December 3—Leeds Metallurgical Society. "Materials for Supersonic Flight." I. L. G. Baillie.

December 3 — Liverpool Metallurgical Society. Library of the Department of Metallurgy of the University of Liverpool, 146 Brownlow Hill, Liverpool, 3. "Basic Aspects of Metal Fatigue." T. Broom. 7 p.m.

December 3—Institute of Metal Finishing. North West Branch. Engineers' Club, Albert Square, Manchester. "Embrittlement in Plating." A. W. Slater. 7.30 p.m.

Metal Market News

COPPER led the way in a fairly general downward movement in non-ferrous metal prices last week, and on Friday afternoon quotations were just about at their lowest point. Consumer business has been very poor, and in some directions it is felt that there will not be much improvement this year. The virtue certainly seems to have gone out of zinc, which has been rather a favourite during the past few weeks. The turnover was not very large, less than 6,000 tons, and the backwardation narrowed from £6 10s. 0d. to £4 10s. 0d. At the close, November was £3 10s. 0d. down at £94, while February, at £89 10s. 0d., showed a loss of £2 10s. 0d. In midweek it was announced that the Board of Trade would sell 3,000 tons of G.O.B. zinc for December delivery to the original suppliers, and although this news did not appear particularly to disturb the market, there can be little doubt that it was a contributory factor in the decline in values. Lead, with a turnover of nearly 7,000 tons, made the best showing of the non-ferrous quartette, for the prompt price was 2s. 6d. up at £71 7s. 6d. while the forward quotation closed 10s. down at £71 15s. 0d. The contango, it will be noticed, came in from 20s. to 7s. 6d. Tin was moderately active with a turnover of 500 tons, but the quotation lost ground and cash, at £795 10s. 0d., was £2 lower on balance. Three months metal closed at £794 10s. 0d., which showed a loss of 30s. At the beginning of the week stocks were reported 449 tons lower at 7,131 tons.

Since L.M.E. stocks of copper were virtually unchanged at 6,808 tons, it looks very much as though all the electrolytic quality metal has now been withdrawn, the residue doubtless consisting of fire refined. In the absence of any further reduction the market gave way, weakness being further accentuated by news that Phelps Dodge had made a settlement with the workers at their Arizona property. On Tuesday the market had news of the October statistics, the details of which came as a great disappointment for everyone had been expecting, reasonably enough, a big fall in stocks. In the event, the total in the United States, at 78,308 short tons, was only about 1,500 down, while outside the U.S.A. there was a fall of about 23,000 short tons. Other items are as follows, in short tons of 2,000 lb. Crude production in the States was 4,900 tons up at 30,986, and refined 400 tons down at 44,218 tons. Deliveries of refined copper dropped from 92,501 to 68,648 tons. Outside the U.S.A., deliveries of crude fell by 5,000 tons to 163,567 tons, and refined by the same amount to 137,498. Deliveries, at 142,297 tons, compared with 139,781 tons in September. It will be noted that deliveries in the States registered a big drop, while production outside the U.S.A. did not reflect the Braden strike.

On the Metal Exchange the course of prices was influenced by an almost complete cessation of consumer demand and the ever-growing expectation that the American copper strike was coming to an end within a few days. Reports were rife about the action being taken by Kennecott, and on Friday it was learned that a settlement had been reached between the company and the steel workers. The afternoon Kerb market was £1 lower than the close of the ring, which was £235 three months and £241 for cash. The backwardation came in from £11 10s. 0d. to £6, the demand for cash having evaporated. The turnover was heavy, about 14,000 tons, and on balance cash lost no less than £18, while three months closed £12 10s. 0d. down. Pending a revival of interest by consumers it looks very much as though the downward trend will continue. In regard to the October statistics, it should be noted that the Copper Institute revised the figure of U.S. refined production from 28,800 short tons to 44,600, and U.S. refined stocks from 61,500 tons to 79,800 tons.

Birmingham

The general outlook can be viewed with optimism, said Major C. R. Dibben, chairman of the Midland Regional Board for Industry, at its monthly meeting. He added that shortage of labour and some materials, particularly sheet steel, is holding up production. Firms most affected by the steel shortage are those making such goods as washing machines and spin dryers. This view is confirmed in other quarters. The general situation is one of increasing work, with practically all sections of the metal-using industries sharing in the revival. There is no shortage of non-ferrous metal, and consumption shows a considerable improvement over the last four months.

In the iron and steel trade, the big improvement in business at the re-rolling mills is bringing a shortage of billets. The supply position seems likely to continue tight for the remainder of the year pending increased output at the mills. Continental material is difficult to obtain even at the high prices prevailing. Some grades of pig iron are also becoming more difficult to secure promptly.

Paris

Péchiney is the first large metal establishment to act upon the advice and wishes of the Government's profit-sharing policy. New stock to the value of around £175,000 is to be issued and distributed among their personnel. It is being paid for out of reserves. The Government has no intention of making profit sharing compulsory, but it has left industry in no doubt that it is prepared to make certain concessions to those firms willing to introduce profit-sharing. Till now the response has been slight. Only large organizations have accepted the invitation.

The trade unions remain hostile to the plan and have stated, as always, that it is a move to keep wages down. For this reason, many small firms in all industries are hesitating. They expect, for example, wage claims to continue and are not prepared, therefore, to introduce profit-sharing.

New York

Copper futures were easier at the end of last week, following London advices and the Kennecott statement that negotiations with the Steel Workers' Union locals were successfully completed. Nearby December recovered somewhat in late dealings, reflecting tightness in nearby copper. In the outside market, dealers said consumers were not buying, watching the market and expecting settlement of the industry copper strike next week. They were believing that cheaper copper will soon be available. However, one leading dealer source said nearby copper will still be strong, even though the copper strike may be over soon, since it will take about a month or so for copper pipelines to refill.

Tin was softer and quiet. Lead and zinc were quiet. In late dealings, tin was steady and quiet. Heavy offerings of scrap copper were reported at unchanged prices. Electrolytic copper was unchanged.

The board of governors of the Commodity Exchange Incorporated have ruled new trades in tin and burlap futures be stopped and outstanding contracts be liquidated. An Exchange official said the order, which became effective last Friday, was made because of the lack of interest in both markets as a result of restricted price movements for the commodities at point of origin.

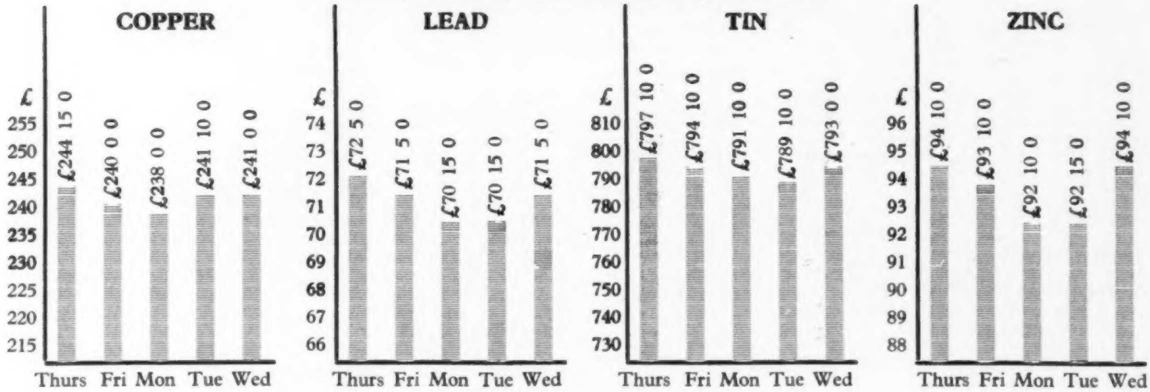
Zurich

Turnover on the Swiss non-ferrous metals market was more or less stable in recent weeks. The internationally-felt shortage of copper and zinc was not reflected in increased buying for stocks in Switzerland, trade quarters state. Ordinary users were cautious because they regarded prices as excessive, while large-scale consumers were safeguarded by long-term contracts. Some copper was bought for future delivery, while the lead and zinc sectors were quiet. The level of tin, nickel and aluminium sales remained unchanged from the previous period. Lately, Switzerland has been importing increased quantities of tin from China and the Soviet Union.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 19 November to Wednesday 25 November 1959



Primary Metals

All prices quoted are those available at 2 p.m. 25/11/59

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	,,	197	0	0
Antimony Metal 99%	,,	190	0	0
Antimony Oxide	,,	180	0	0
Antimony Sulphide Lump	,,	190	0	0
Antimony Sulphide Black Powder	,,	205	0	0
Arsenic	,,	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	,,		9	6
Calcium	,,	2	0	0
Cerium 99%	,,	16	0	0
Chromium	,,		6	11
Cobalt	,,		14	0
Columbite	per unit		—	
Copper H.C. Electro	ton	241	0	0
Fire Refined 99·70%	,,	240	0	0
Fire Refined 99·50%	,,	239	0	0

		£	s.	d.
Copper Sulphate	ton	78	10	0
Germanium	grm.		—	
Gold	oz.	12	10	1¾
Indium	,,		10	0
Iridium	,,	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	71	5	0
Magnesium Ingots	lb.		2	0
Notched Bar	,,		2	9½
Powder Grade 4	,,		6	1
Alloy Ingot, A8 or AZ91	,,		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	72	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	,,		5	6
Osmium	oz.		nom.	
Osmiridium	,,		nom.	

		£	s.	d.
Palladium	oz.	8	0	0
Platinum	,,	28	10	0
Rhodium	,,	41	0	0
Ruthenium	,,	18	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	8¼
Tellurium	lb.		18	0
Tin	ton	793	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	,,		—	
Virgin Min 98%	,,	92	6	3
Dust 95/97%	,,	126	0	0
Dust 98/99%	,,	132	0	0
Granulated 99+%	,,	117	0	0
Granulated 99·99+%	,,	134	5	0

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏£/ton	Canada c/lb	≏£/ton	France fr/kg	≏£/ton	Italy lire/kg	≏£/ton	Switzerland fr/kg	≏£/ton	United States c/lb	≏£/ton
Aluminium			22.50	185 17 6	224	168 0	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					230	171 10	450	265 10			29.00	232 0
Cadmium					1,300	975 0					130.00	1,040 0
Copper												
Crude												
Wire bars 99.9							500	295 0				
Electrolytic	35.00	257 12 6	30.00	247 17 6	345	258 15			3.00	255 0	33.00	264 0
Lead			10.75	88 12 6	103	77 5	169	99 15	.91	77 7 6	13.00	104 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50	637 10	74.00	592 0
Tin	110.50	813 12 6			1,119	839 2 6	1,510	891 0	9.75	828 17 6	100.87	807 0 0
Zinc												
Prime western			12.75	105 7 6								
High grade 99.95			13.35	110 5 0								
High grade 99.99			13.75	113 12 0								
Thermic					132.00	99 0 0						
Electrolytic					140.00	105 0 0	209	123 7 6	1.20	102 0	14.00	112 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 25/11/59

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10....	„	221	0	0
B.S. 1490 L.M.11....	„	215	0	0
B.S. 1490 L.M.12....	„	223	0	0
B.S. 1490 L.M.13....	„	216	0	0
B.S. 1490 L.M.14....	„	224	0	0
B.S. 1490 L.M.15....	„	210	0	0
B.S. 1490 L.M.16....	„	206	0	0
B.S. 1490 L.M.18....	„	203	0	0
B.S. 1490 L.M.22....	„	210	0	0

Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	159	0	0
B.S. 1490 L.M.2	„	169	0	0
B.S. 1490 L.M.4	„	184	0	0
B.S. 1490 L.M.6	„	185	0	0

*Aluminium Bronze				
BSS 1400 AB.1......	ton	244	0	0
BSS 1400 AB.2......	„	253	0	0

*Brass		£	s.	d.
BSS 1400-B3 65/35 ..	ton	160	0	0
BSS 249............	„	—		
BSS 1400-B6 85/15 ..	„	210	0	0

*Gunmetal				
R.C.H. 3/4% ton	„	—		
(85/5/5/5) LG2	„	198	0	0
(86/7/5/2) LG3	„	208	0	0
(88/10/2/1)	„	255	0	0
(88/10/2/½)	„	265	0	0

*Manganese Bronze				
BSS 1400 HTB1	„	193	0	0
BSS 1400 HTB2	„	209	0	0
BSS 1400 HTB3	„	222	0	0

Nickel Silver				
Casting Quality 12%	„	242	0	0
„ „ 16%	„	247	0	0
„ „ 18%	„	267	0	0

*Phosphor Bronze				
B.S. 1400 P.B.1. (A.I.D. released)..........	„	297	0	0
B.S. 1400 L.P.B.1....	„	218	0	0

**Average prices for the last week-end.*

Phosphor Copper		£	s.	d.
10%	ton	264	0	0
15%	„	266	0	0

Phosphor Tin				
5%	„	—		

Silicon Bronze				
BSS 1400-SB1	„	263	0	0

Solder, soft, BSS 219				
Grade C Tinmans....	„	366	15	0
Grade D Plumbers ..	„	295	0	0
Grade M	„	402	15	0

Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.	—		
Type 9 „	„	—		

Zinc Alloys				
B.S.S.1004 Alloy A ..	ton	127	10	0
B.S.S.1004 Alloy B ..	„	131	10	0
Sodium-Zinc	lb.		2	8

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8¼
Sheet 18 S.W.G.	„		2	10¼
Sheet 24 S.W.G.	„		3	1¼
Strip 10 S.W.G.	„		2	8¼
Strip 18 S.W.G.	„		2	9¼
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2¼
Circles 18 S.W.G.	„		3	1¼
Circles 12 S.W.G.	„		3	0¼
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11¼
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

Aluminium Alloys				
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3¼
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2¼
Strip 24 S.W.G.	„		3	10¼
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9¼
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0¼
Strip 10 S.W.G.	„		3	10¼
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9¼
BS1477. HPC15WP.				
Plate heat treated..	„		6	3¼
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10¼
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0¼
BS1476. HE10WP.				
Sections	„		3	1¼

Brass				
Tubes	„		1	11
Brazed Tubes........	„		3	1
Drawn Strip Sections	„		3	1¼
Sheet	ton	207	5	0
Strip	„	207	5	0
Extruded Bar........	lb.		2	1¼
Extruded Bar (Pure Metal Basis)	„		—	

Brass				
Condenser Plate (Yellow Metal)	ton	205	0	0
Condenser Plate (Naval Brass)	„	217	0	0
Wire	lb.		2	8⅞

Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9

Copper				
Tubes	lb.		2	3⅜
Sheet	ton	270	0	0
Strip	„	270	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	292	15	0

Gupro Nickel				
Tubes 70/30	lb.		3	7⅞

Lead				
Pipes (London)	ton	114	15	0
Sheet (London)	„	112	10	0
Tellurium Lead	„	£6 extra		

Nickel Silver				
Sheet and Strip 7% ..	lb.		3	10¾
Wire 10%	„		4	5½

Phosphor Bronze				
Wire	„		4	1⅛

Titanium (1,000 lb. lots)			
Billet 4½" to 18" dia...	lb.	54/-	55/-
Rod ½" to 4" dia.	„	95/-	62/-
Wire ·036"-·232" dia.	„	167/-	110/-
Strip ·003" to ·048" ..	„	200/-	75/-
Sheet 8'×2'. 20 gauge	„	85/-	
Tube, representative average gauge	„	300/-	
Extrusions	„	105/-	

Zinc				
Sheet	ton	127	15	0
Strip	„	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 24/11/59.

Aluminium	£
New Cuttings	151
Old Rolled	134
Segregated Turnings	108

Brass	
Cuttings	166
Rod Ends	151
Heavy Yellow	125
Light	119
Rolled	150
Collected Scrap	120
Turnings	144

Copper	
Wire	213
Firebox, cut up	200
Heavy	195
Light	190
Cuttings	213
Turnings	190
Braziery	160

Gunmetal	£
Gear Wheels	175
Admiralty..................	175
Commercial	162
Turnings	157

Lead	
Scrap	61

Nickel	
Cuttings	—
Anodes	550

Phosphor Bronze	
Scrap	162
Turnings	157

Zinc	
Remelted	86
Cuttings	73
Old Zinc	52

Financial News

Foundry Services

It has been reported that Minerals Separation has recently purchased an additional interest in the Foundry Services group, comprising 20 per cent of the issued capital of Foundry Services (Holdings) Ltd. This, it is said, increases the company's interest in Foundry Services to 80 per cent.

Roan Antelope Copper

Group net profit, year to June 30, 1959, £2,975,242 (£1,456,056) and dividend 10d. (5d.) per 5s. unit. Fixed assets £11,499,251 (£10,838,082), trade investments £6,105,939 (£5,525,556) and current assets £14,977,248 (£13,821,327). Current liabilities, etc., £9,434,751 (£8,250,905). Reserves £4,509,263 (£3,431,619).

Fischer Bearings Co. Ltd.

It has been announced by the Timken Roller Bearing Co. Ltd. and the Fafnir Bearing Company, of New Britain, Conn., U.S.A., that an agreement will shortly be concluded by which a recently-formed subsidiary of the latter company, Fafnir Bearing Co. Ltd., will purchase the business of Fischer Bearings Co. Ltd., a Timken subsidiary.

The sale of Fischer, which was until recently owned by the former British Timken Ltd., results from the Timken decision to confine their interest to the manufacture of tapered roller bearings throughout the world. It is intended that Fafnir's British products will be marketed under the Fafnir name. Mr. Stanley M. Cooper, chairman of Fafnir, will assume the position of chairman and managing director of the English company and will direct reorganization and expansion, assisted by Mr. William L. Hubbard.

An Amalgamation

It is understood that an amalgamation of Ether Ltd. and the J. Langham Thompson group is proposed. It is reported that Ether Ltd. will acquire the capital of the latter firm for a consideration of £520,833 in cash and 227,340 ordinary 5s. shares. To provide the cash and additional liquid resources there is to be a one-for-two "rights" issue of 672,660 ordinary 5s. shares at £1 a share. An extraordinary meeting of Ether is expected to be held next month for the purpose of increasing the authorized capital while a further meeting is to be held in the new year to decide on changing the name of the company, probably to Ether Langham Thompson.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Lenstan Metal Workers Limited (639728), Lower Pontnewydd, Cwmbran, Mon. Registered October 15, 1959. Nominal capital, £100 in £1 shares. Directors: Stanley Whitehouse, Leonard Wright, Stanley T. Johnson and Albert G. Anthany.

White Bronze Co. Limited (639943), 2-4 Dingwall Ave., Croydon. Registered October 19, 1959. To carry on business of engineers, etc. Nominal capital, £1,000 in £1 shares. Directors: Benjamin Newton and Percy O. Davis.

E. Wheeler (Metals) Limited (639957), King Street, Old Hill, Staffs. Registered October 19, 1959. To carry on business of salvage buyers, scrap iron merchants, machinery and metal merchants, etc. Nominal capital, £2,500 in £1 shares. Directors: Jack E. Wheeler and Mrs. G. Wheeler.

Tube Benders Limited (640474), Caxton Way, Stevenage, Herts. Registered October 26, 1959. To take over business of manufacturing and dealing in tube bending machines and/or apparatus formerly carried on at Stevenage by Hilmor Ltd., etc. Nominal capital, £125,000 in £1 shares (31,270 cum. red. pref.). Directors: John A. Hawes, Eric J. Hampson and Winifred E. Huggett.

F. Corry (Metallurgists) Ltd. (640379), 19 Sudbury Court Drive, Harrow, Middx. Registered October 26, 1959. Nominal capital, £4,000 in £1 shares. Directors: Fred Corry, Mrs. Alma G. Corry and Frederick S. Picking.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (francs per kilo):

Electrolytic copper scrap	(£202.12.6)	270
Heavy copper	(£202.12.6)	270
No. 1 copper wire	(£187.12.6)	250
Brass rod ends	(£138.15.6)	185
Zinc castings	(£57.12.6)	85
Lead	(£69.0.0)	92
Aluminium	(£135.0.0)	180

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£200.15.0)	340
Lead, soft, first quality	(£81.10.0)	138
Lead, battery plates	(£46.0.0)	78
Copper, first grade	(£236.0.0)	400
Bronze, commercial gunmetal	(£182.17.6)	310
Brass, heavy	(£159.7.6)	270
Brass, light	(£144.12.6)	245
Brass, bar turnings	(£150.10.0)	255
Old zinc	(£56.0.0)	95

Japan (Yen per metric ton):

Electrolytic copper	(£—)	335,000
Copper wire No. 1	(£—)	305,000
Copper wire No. 2	(£—)	255,000
Heavy copper	(£—)	300,000
Light copper	(£—)	250,000
Brass, new cuttings	(£—)	213,000
Red brass scrap	(£—)	223,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£223.17.6)	256
Heavy copper	(£222.12.6)	254
Light copper	(£189.5.0)	216
Heavy brass	(£132.5.0)	151
Light brass	(£100.15.0)	115
Soft lead scrap	(£59.17.6)	68
Zinc scrap	(£48.2.6)	55
Used aluminium unsorted	(£105.2.6)	120

Trade Publications

Gear Units—Crofts (Engineers) Ltd., Bradford.

Covering 24 pages, this catalogue details the standard range of Crofts spur and worm double reduction gear units. Specifications, statistics, diagrams and photographs are included.

Polygon Tool Box.—Thomas Chatwin and Co. Ltd., Great Tindal Street, Birmingham 16.

The versatile polygon tool box, with which components can be produced in hexagon, octagon, square and other shapes from round stock entirely by turning operations, is described in a new 40-page illustrated brochure issued by this member of the Brockhouse group. The brochure is in sectional form and outlines the various functions of the box and includes detailed operating instructions and diagrams. Also included are a number of tabulated charts showing capacities of the box when fitted to capstan and turret lathes, single and multi-spindle automatics and special machines. Copies of the brochure may be obtained from the company.

Colloidal Graphite—Colloidal Dispersions—The Morgan Crucible Co. Ltd., Battersea Church Road, London, S.W.11.

Technical literature dealing with these two subjects have just been issued. One deals with "Foliac" colloidal graphite in the power station, and the other with "Foliac" colloidal dispersions and their applications. Both are in colour and details are accompanied by illustrations.

Mineral Dressing. — Head Wrightson Colliery Engineering Ltd., 46 Rutland Park, Sheffield (and 20 Buckingham Gate, London, S.W.).

Two recent publications from this company deals first with the Cyclone Washer for mineral concentration at the lower size ranges, and the second with the Stripa Process. The brochure describing this latter process shows the simple flowsheet and plant requirements of the process together with applications of the process. Illustrations accompany the publications.

Portable Electric Mould Driers.—Electric Resistance Furnace Co. Ltd., Netherby, Queens Road, Weybridge, Surrey.

The Efco-Brown Boveri driers are illustrated and described in a four-page leaflet issued. These driers are designed for drying floor moulds or large box moulds for ferrous and non-ferrous metal castings.

Sulfuric Acid Plants—Chemical Construction (G.B.) Limited, 9 Henrietta Place, London, W.1.

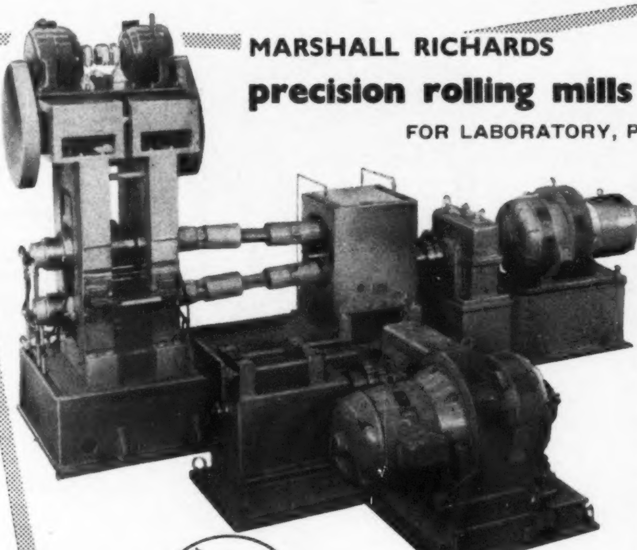
This new brochure has been designed to allow sulphuric acid manufacturers to select any one of over 750 variations obtainable on sulphur-burning sulphuric acid plants. The brochure features a pictorial flow sheet employing a number of flaps. Each item of equipment is numbered and carries a description of its employment and, where available, its alternative. The basic plant is shown indicated with brown numbers; alternative equipment is shown with blue numbers. A check card is provided on the brochure where the manufacturer may record his choice of plant, and the brochure can also be usefully employed in existing plants where minor modifications are contemplated.

THE STOCK EXCHANGE

Steady Buying Of Steel And Engineering Shares Resulted In Renewed Strength

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 23 NOVEMBER	+RISE — FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	31/6	—6d.	9	9	5 14 3	33/3	23/3	24/9	17/6
400,000	2/–	Anti-Attrition Metal	1/3		4	8¼	6 15 0	1/6	1/3	1/9	1/3
41,303,829	Stk. (£1)	Associated Electrical Industries ...	60/6xd	—3/3	15	15	4 19 3	67/–	54/–	58/9	46/6
1,613,280	1	Birfield	68/–	—6d.	15	15	4 8 3	75/–	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	105/–	+2/–	20	17½	3 16 3	108/9	72/–	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	65/6	+5/–	12½	11	3 19 6	65/6	36/1½	39/–	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/9		5	5	6 7 0	16/3	15/–	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	20/–		6	6	6 0 0	20/–	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	45/–		10	10	4 9 0	45/–	27/6	28/9	24/–
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	15/6	14/–	16/–	15/–
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6		7	7	6 16 6	20/6	20/–	20/4½	19/–
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	20/9	+1/–	6	6	5 15 9	20/9	18/9	20/–	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	51/9xd	—3/6	12½	12½	4 15 9	61/–	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	75/3	—1/9	10	10	2 13 3	79/6	49/3	52/–	28/3
1,200,000	Stk. (5/–)	Canning (W.) & Co.	15/6	—4½d.	25+ *2½C‡	25	4 0 6	16/9	12/3	25/3	19/3
60,484	1/–	Carr (Chas.)	1/10½	—1½d.	12½	25	6 13 3	2/10½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	25/9xd	+9d.	10H	10	7 15 3	27/–	22/6	22/–	16/–
45,000	1	Ditto Cum. Pref. 6%	16/9		6	6	7 3 3	17/–	15/3	16/–	15/–
250,000	2/–	Coley Metals	3/6		15	20	8 11 6	4/–	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	70/–	—4/–	15	18¾	4 5 9	75/9	59/–	65/3	41/–
1,509,528	1	Davy & United	103/–	—4/–	30‡	20	2 18 3	107/–	43/1½	87/–	45/9
6,840,000	5/–	Delta Metal	21/9	—1/–	31‡	30	3 11 3	23/6	12/–	25/–	17/7½
5 296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	54/9xd	—3/3	15	12½	5 9 0	60/–	36/7½	38/–	22/9
750,000	1	Evered & Co.	36/9		10§	15D	5 8 9	36/9	30/–	30/–	26/–
18,000,000	Stk. (£1)	General Electric Co.	43/–	—6d.	10	10P	4 13 0	48/9	30/–	40/6	29/6
1,500,000	Stk. (10/–)	General Refractories Ltd.	46/3	+6d.	20	20	4 6 6	46/3	31/9	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	67/3	+3d.	16½	15	4 18 3	67/–	63/–	67/6	61/–
750,000	5/–	Glacier Metal Co. Ltd.	10/–	—3d.	11½	11½	5 15 0	10/3	6/7½	8/3	5/–
1,750,000	5/	Glynwed Tubes	26/–		20¶	20	3 17 0	26/3	16/4½	18/1½	12/10½
5,421,049	10/–	Goodlass Wall & Lead Industries ...	47/6	—1/–	13‖	18D	2 14 9	49/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	112/6	+2/6	30	20	5 6 9	112/6	75/–	57/9	45/–
396,000	5/–	Harrison (B'ham) Ord.	25/3	—1/-	*17½	*15	3 9 3	26/3	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	19/6	19/3	19/9	18/4½
1,075,167	5/–	Heenan Group	14/7½		15	10	5 2 6	15/–	7/6	9/7½	6/9
246,209,422	Stk. (£1)	Imperial Chemical Industries ...	55/9		12DZ	10	2 17 6	58/9	33/9	38/–	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	18/9		5	5	5 6 9	18/10½	16/–	17/1½	16/–
14,584,025	**	International Nickel	186	+4½	$3	$2.60	2 17 6	187⅞	154½	169	132⅞
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/9	—6d.	5	5	6 7 0	16/3	15/4½	16/9	15/–
6,000,000	1	Ditto Ord.	48/–	—9d.	12D	10	3 6 9	49/–	29/7½	47/–	36/6
600,000	10/–	Keith, Blackman	31/3		17½E	15	4 7 0	31/3	25/–	28/9	15/–
320,000	4/–	London Aluminium	6/10½	—4½d.	10	10	5 16 3	8/3	5/3	6/–	3/–
765,012	1	McKechnie Brothers Ord.	60/–	+1/6	15F	15	5 0 0	63/9	41/–	45/–	32/–
1,530,024	1	Ditto A Ord.	58/9	+9d.	15F	15	5 1 3	62/–	38/9	45/–	30/–
1,108,268	5/–	Manganese Bronze & Brass	17/–	—1/–	20⅝	20	6 0 9	18/6	13/9	14/1½	8/9
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	77/–	—2/–	11	11	2 8 0	80/–	44/7½	73/3	40/6
415,760	Stk. (2/–)	Metal Traders	10/–		50	50	10 0 0	12/3	8/4½	9/–	6/3
160,000	1	Mint (The) Birmingham	31/6		10	10	6 7 0	31/6	22/–	22/9	19/–
80,000	5	Ditto Pref. 6%	80/–		6	6	7 10 0	80/–	69/–	83/6	69/–
5,187,938	Stk. (£1)	Morgan Crucible A	57/–xcap	+5/6	10ɸ	10	2 10 0	51/6	30/7½	45/–	34/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/6		5½	5½	5 19 0	18/6	17/6	18/–	17/–
2,200,000	Stk. (£1)	Murex	63/9	+6d.	15	17½	4 13 9	63/9	41/–	58/9	46/–
468,000	5/–	Ratcliffs (Great Bridge)	13/6		10R	10	2 15 6	13/6	9/6	11/1½	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	55/–		25	20	4 11 0	55/–	27/9	27/3	24/6
1,365,000	Stk. (5/–)	Serck	30/–	—3d.	17½GB	15	2 18 3	30/9	18/–	18/7½	11/–
6,698,586	Stk. (£1)	Stone-Platt Industries	60/9	—9d.	15	15	4 18 9	63/–	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	18/3	+6d.	5½	5½	6 0 6	18/3	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	120/3	+2/9	20	17½	3 6 6	121/3	72/–	86/–	48/4½
41,000,000	Stk. (£1)	Vickers	29/3	—9d.	10	10	6 16 9	37/–	27/4½	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 9	15/0¾	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	23/–		*5	*5	6 9 6A	23/–	20/6	23/–	21/3
2,200,000	1	Ward (Thos. W.), Ord.	146/6	+2/9	25	20	3 8 3	147/6	83/–	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	57/6	+4/9	10	10	3 9 6	53/9	39/9	46/6	32/6
225,000	2/–	Wolverhampton Die-Casting ...	11/6xd	—6d.	30	30	5 4 3	13/3	8/8¼	10/1½	7/–
591,000	5/–	Wolverhampton Metal	31/–		27½	27½	4 8 9	32/6	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	7/3		20	20	6 18 0	7/6	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	14/3	+6d.	6	6	8 8 6	13/9	12/10½	13/–	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/6	+1½d.	27	40D	7 14 3	3/9¾	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. D And 50% capitalized issue. C **Paid out of Capital Profits.** E and 50% capitalized issue in 7% 2nd Pref. Shares. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. ¶ Interim since increased from 10% to 12%. ɸ And 40% capitalized issue. Z Interim since increased. B And proposed 50% capitalized issue. G And 1¾d. special distribution. F And special 5% tax free dividend. H And Capital Dividend of 7½%.



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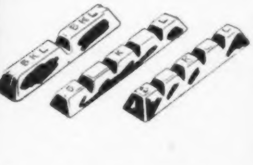

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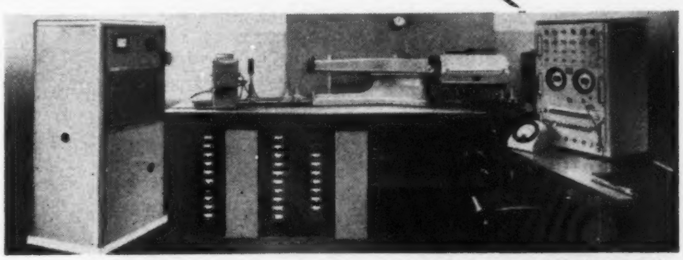

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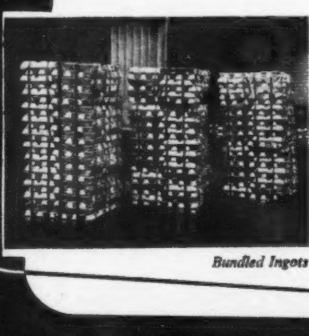

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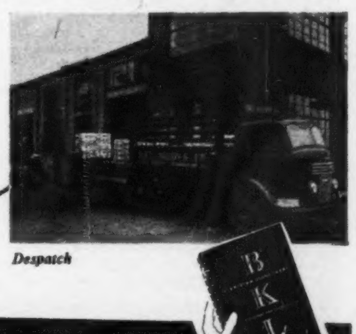

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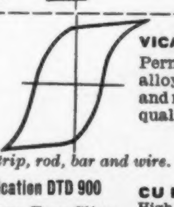

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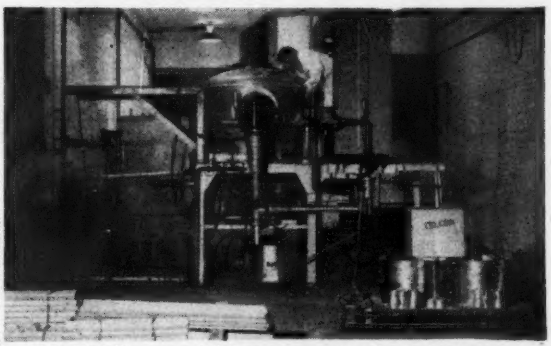

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